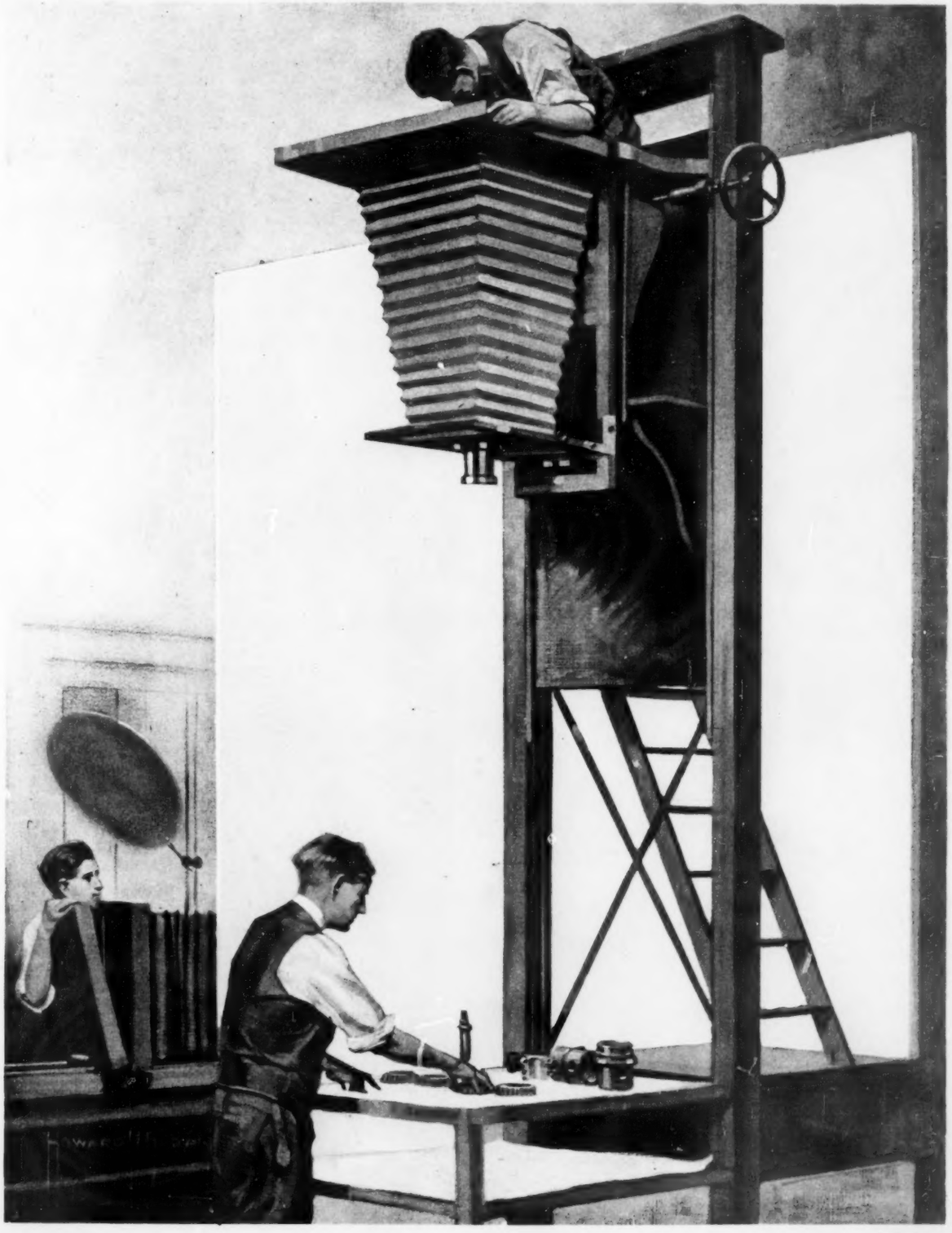
IN THIS ISSUE:

OUR COAL IN THE MAKING
TAMING THE RIVER NILE

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



USING THE VERTICAL CAMERA TO PHOTOGRAPH AUTOMOBILE PARTS.—[See page 527]

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November 20, 1920

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. . . and at New York's Home of Grand Opera

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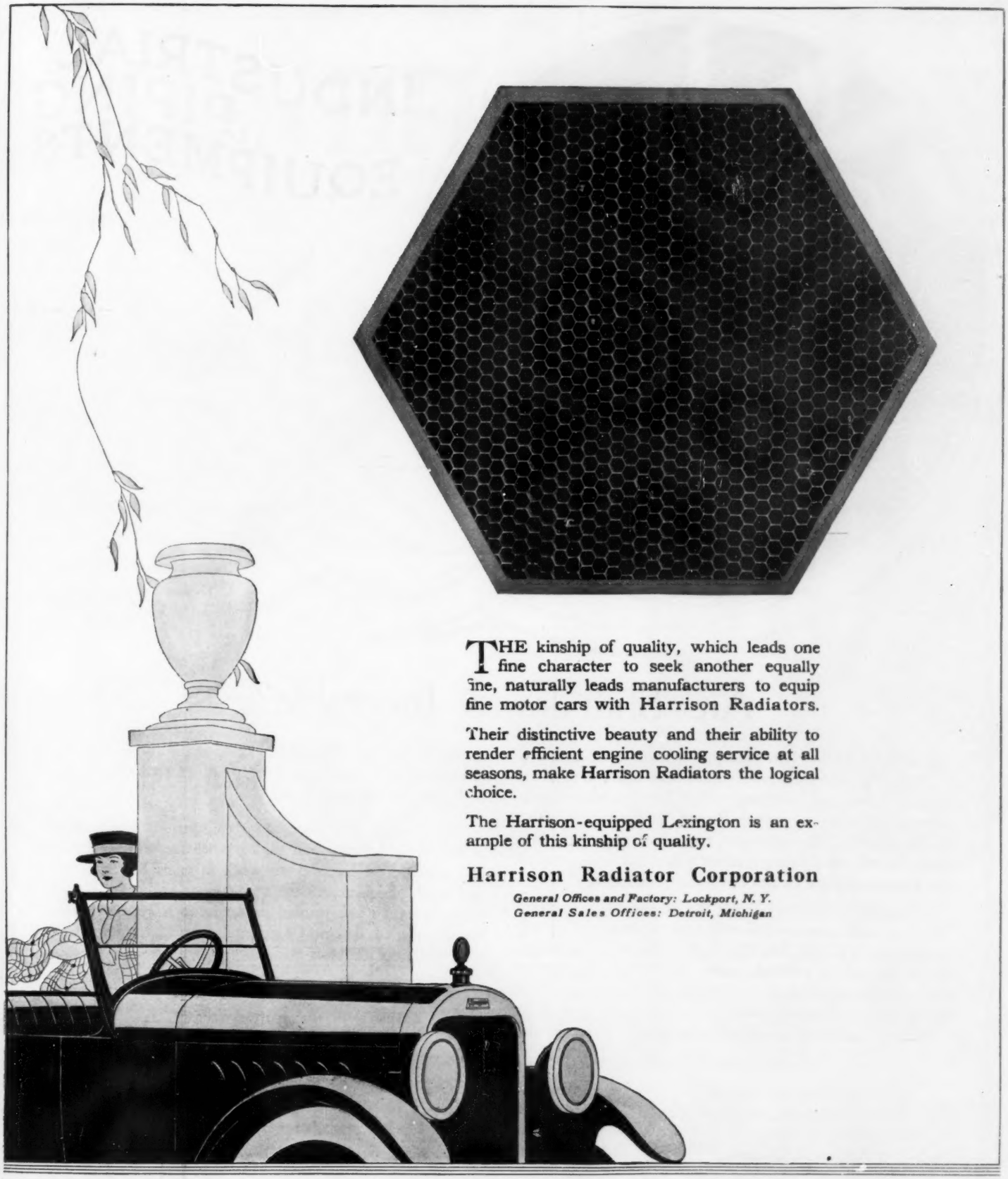

THE kinship of quality, which leads one fine character to seek another equally fine, naturally leads manufacturers to equip fine motor cars with Harrison Radiators.

Their distinctive beauty and their ability to render efficient engine cooling service at all seasons, make Harrison Radiators the logical choice.

The Harrison-equipped Lexington is an example of this kinship of quality.

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HARRISON *Original Hexagon Cellular* Radiators

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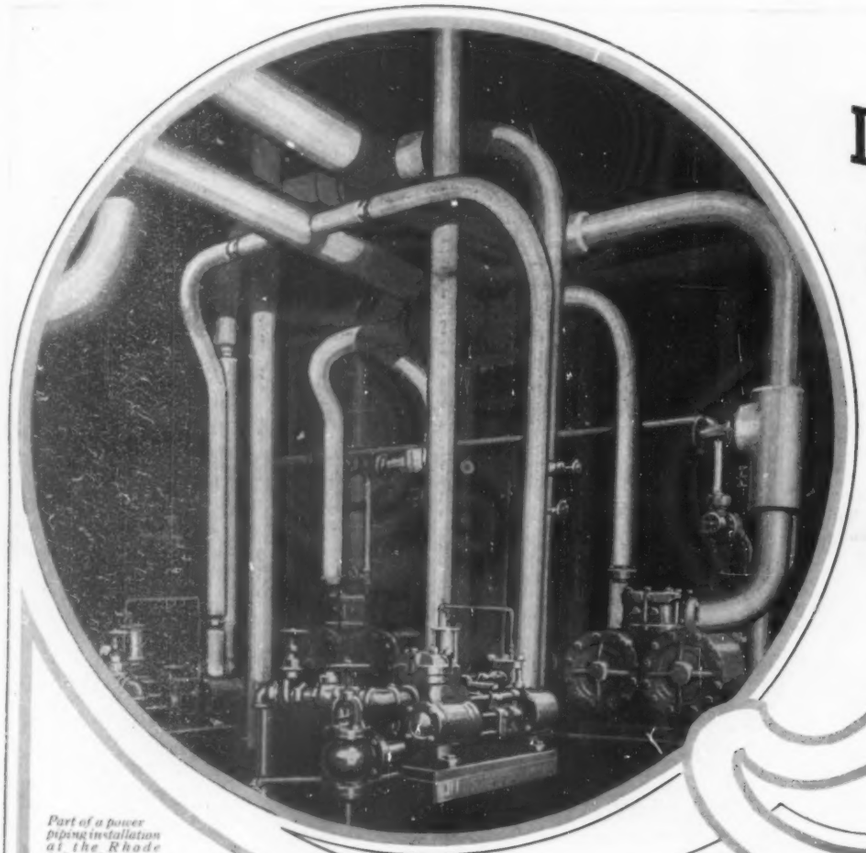

Part of a power piping installation at the Rhode Island Co., Providence, R. I.

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SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 21

NEW YORK, NOVEMBER 20, 1920

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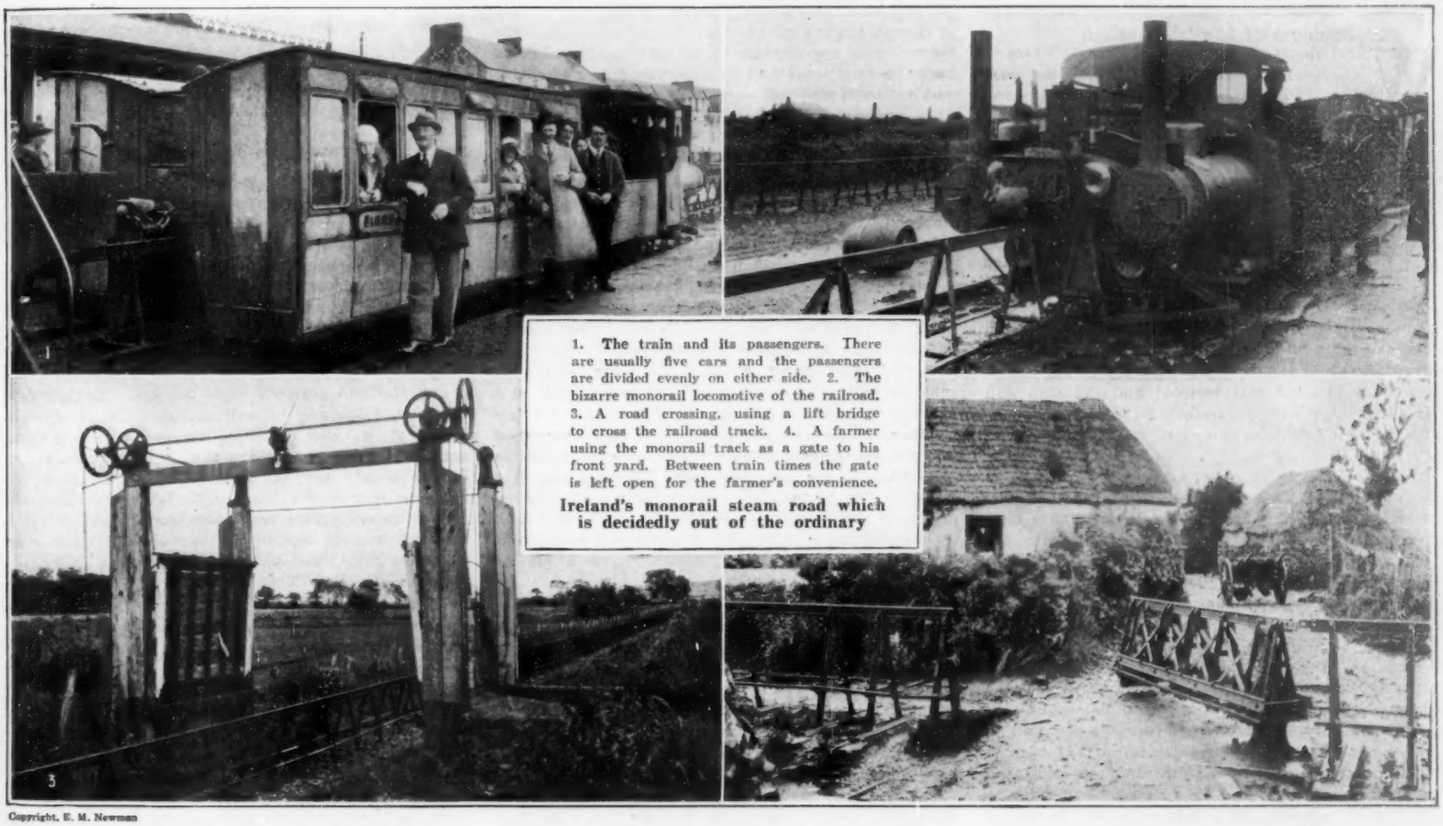

1. The train and its passengers. There are usually five cars and the passengers are divided evenly on either side. 2. The bizarre monorail locomotive of the railroad. 3. A road crossing, using a lift bridge to cross the railroad track. 4. A farmer using the monorail track as a gate to his front yard. Between train times the gate is left open for the farmer's convenience.

Ireland's monorail steam road which is decidedly out of the ordinary

Copyright, E. M. Newman

A Curious Little Monorail Road in Ireland

THE odd little locomotive, cars, and track, of which we show several views, are to be found in a picturesque part of Ireland beloved by the tourist, for it runs from Killarney to Bally Bunion. In spite of its novelty, at least to American eyes, it is by no means new, for it has been serving the district through which it runs for lo, these many years.

During the closing years of the nineteenth and the opening of the twentieth centuries, railroads running on a single track had quite a vogue, particularly among people of an inventive turn of mind. Steel rails cost money, and so do the broad track and expensive ties on which the rail is laid. How natural, then, to seek an escape from the high cost of railroad construction by cutting the width of the tracks in half, throwing out one rail altogether, and reducing the number of wheels beneath the locomotives and cars by one-half.

The attempt to build a satisfactory monorail system produced a great variety of designs, many of which were illustrated from time to time in the SCIENTIFIC AMERICAN. There was the overhead monorail, as used in Germany, in which the cars are suspended by means of what is actually a massive hook from a pair of little trolleys which engaged the single overhead carrying rail. Another system which was tried out on a short length of trolley line running to City Island, New York, had a single track laid upon the roadbed with a steadying overhead rail, carried on standards at the side of the track, which was placed above the cars and was engaged by a pair of small wheels carried in a stout rigid rig extending from the roof of the car.

The Bally Bunion monorail system is practicable, but we believe has never been extended beyond its present length and has never shown any advantages over the standard system of railroad track construction which would warrant the system being brought into extensive use. The carrying rail is mounted at the apex of a series of A-frames which are bolted down to short wooden ties. At about one-third of the height of the A-frame is mounted a pair of steadying rails which engage rollers on the cars and serve to keep the rolling stock in a vertical position.

The latter is built in two sections; and this is carried so far that steam is generated in two diminutive little boilers which are mounted one on each side of the track. The cars also are built in two halves, and, like the locomotives, they are carried by plate-steel frames in which the main carrying wheels for transferring the load to the track are mounted. The cars are of the well-known British and continental pattern, with separate compartments and a side door to each compartment. Very curious is the simplicity of the track arrangements of this railroad. Take note of the road crossing, in which the roadbed consists of two hinged, counter-weighted leaves, which are raised and lowered by means of chain and pulley on each side of the track. A decided curiosity is our picture of an Irish cottage, where the gate to the yard consists of a section of the track which is so mounted on a vertical standard at one end, that it can be swung open for a wagon and shut for a train.

Living Bean Poles

AS the nation's lumber supply has dwindled and market prices for wood risen markedly, substitutes for wood have been originated. The paper boxes now in such extensive use as shipping packages are some such. The garden is a queer place to look for substitutes for wood, but you can find them there.

A gardener in an eastern State remarked the other day that he believed bean-poles would cease to be common sights in city backyard gardens because of their cost and the difficulty of obtaining them. He said that a substitute for them had been found—the Giant Russian sunflower. Many small gardeners last season used sunflowers for poles. They planted two or three seeds with each hill of climbing beans, and thinned to leave one sunflower plant to each hill.

Up this live "pole" the beans twined and ascended. The gardener kept all leaves off the sunflower except several at the very top. They made excellent poles, yielded a crop of their own, and were cheap. Low cost, and the convenience with which they are provided, are big advantages of the sunflower bean-pole.

Of course, the sunflower isn't the first make-shift bean-pole. Throughout those farming regions of America where wood is scarce, climbing beans for decades have been planted almost wholly in the corn. There are Western farmers who don't know what you mean when you speak of "pole" beans. They call them "cornstalk" beans, because of the universal use of the makeshift pole. A cornfield is not an ideal place for beans, however, because of the degree of shade.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Problem of the "Leviathan"

WITH the three largest transatlantic liners in the world for sale and no bidders, the question presents itself as to whether dimensions, speed and luxurious appointments have not been pushed too far, even to the point of *reductio ad absurdum*.

The public is more or less familiar with the case of the "Leviathan," formerly the "Vaterland" of the Hamburg-American Line, which made her maiden trip to this port a few weeks before the war, and with the exception of a term of service as a transport, has been tied up continuously at her dock at Hoboken for the past six years. Subsequent to the armistice, the Government offered this magnificent liner for sale, and a bid of $3,000,000 was put in with a proviso that the Government should make a loan, at a low rate of interest, of $6,000,000 to enable the company to put her in condition. The bid was rejected and the ship still lies at her pier with a caretaking crew aboard, who with grease, oil can and paint pot, are doing their best to prevent deterioration.

The original cost of this 54,000-ton ship, although she was built at pre-war prices under the economical system of a first-class German yard, must have been from $8,000,000 to $10,000,000. To reproduce the ship today would cost twice that sum, and the cost might well run up to $25,000,000. True it is that the cost of reconditioning the ship and turning her into an oil burner would be heavy. On the other hand passenger rates on a ship of her class are proportionately high, if not higher, and once in service she should attract the cream of American travel to herself—provided the cuisine and general service were begun and maintained at the high level reached by her competitors. Failing that she would be an unutterable failure.

We are rather inclined to think that the reluctance among our shipping men to take charge of the "Leviathan," either by outright purchase or by charter, is due in some measure to a conscious lack of experience in what might aptly be called the floating hotel business. On the technical side they have no anxiety whatever, for our engineer force got greater speed out of the "Leviathan" when she was in transport service than she had ever shown in German hands, and as navigators our merchant officers are second to none. But when it comes to receiving some three thousand people aboard ship, and feeding and housing them with the delicacies and comforts of public hotel or private home, the problem assumes stupendous proportions and calls for long experience and very expert skill. It is one thing to run a 5,000-ton passenger ship to the West Indies but quite another thing to run a 54,000-ton "Leviathan" to Europe.

Another of the big ships that is on the list for sale is the "Bismarck," sister to the "Leviathan" and built at the same yard on the same building ways. Work was carried on in a desultory way upon her during the war, and Germany has undertaken to complete the ship and place her at the disposal of the Allies. Structurally she is complete, we believe, the unfinished work consisting of the fitting and furnishing of the passenger accommodations. The Germans are urging that she be broken up and the material be used in the construction of ships of a more usable size. So far as ownership is concerned, she has passed out of their hands, but the suggestion shows that her builders are disposed to look upon this huge passenger ship as something of a white elephant. This much is certain, that among the many rumors regarding the "Bismarck" there has never been so much as a hint of a prospective purchaser.

The third ship, "Imperator" of 52,000 tons, was apportioned to Great Britain as part of the compensation for the destruction of 9,000,000 tons of her shipping during the war. She is being operated by the Cunard Company pending her sale; but apparently no satisfactory bids have been received, for she is still Government property and is likely to remain so for some months to come.

Why Not the Torpedo Motor Boat Carrier?

IN the contest last summer for the Harmsworth Cup the race was won by a little 26-foot motor boat which is credited with an official speed of 70 miles an hour. It detracts nothing from the credit of the victory to say that "Miss America" consisted of a pair of Liberty engines with a boat built around them. She showed what the gasoline motor was capable of doing under extreme conditions of maximum power of engine and minimum size and weight of boat.

To the serious naval constructor, who at no time in the progress of his art has been hedged about with so many and so difficult problems as today, the mere fact that any kind of a sea craft has made 70 miles an hour should be a matter of great significance. He knows full well that, starting with a basis of two Liberty motors, or 800 horse-power, which is what "Miss America" carried, it would be possible to build a torpedo-carrying motor boat whose offensive power could be increased in proportion as speed was sacrificed. To put it more concretely, he could make a guess offhand that a modified motor boat of the "Miss America" type, larger, stronger and more seaworthy, could be built that would carry a 21-inch torpedo at a speed of 40 knots. "Miss America" was built for fair weather and smooth water, and it is well understood that the phenomenal speed of these little craft falls in proportion as the seas run high. Nevertheless it is quite possible, by increasing the size and modifying the model, to produce high-speed craft which will hold their speed under conditions in which the out-and-out hydroplane of the "Miss America" type would be helpless.

Rear-Admiral Taylor, Chief Constructor, in his recent masterly summing up of the naval lessons of the war before the Franklin Institute, commented favorably upon the work done by Allied motor torpedo boats during the war. "The little boats," he said, "performed splendid service off the Belgian coast," referring, no doubt, to the British 40-knotters, which, on their very first cruise sank a German destroyer. He stated also that "the most spectacular and at the same time most valuable service performed by boats of this type was the daring penetration by the Italians into a fortified Austrian harbor, where they sank a battleship lying at anchor. Later, in operations against the Bolshevists, a small British flotilla penetrated to the inner harbor of Kronstadt, where they succeeded in sinking two battleships and two other large vessels."

These performances seem the more remarkable when we remember that they were accomplished by experimental vessels, the first of their type to be built. Subsequent improvements, as worked out in this country, are in the direction of greater size and seaworthiness, coupled with a wider range of action, better accommodations for the crew, and ability to carry the largest torpedoes.

The point is made by the naval constructor that the objection to such craft is that they are too small to keep the sea with the main fleet. It is undeniable, on the other hand that, were it possible to take two or three flotillas of 40-knot, torpedo-carrying motor craft into such an action as that at Jutland, they would inevitably exercise a controlling influence on the tactics of the battle, and might well prove to be its deciding factor; for we must remember that there was a calm sea at Jutland throughout the whole of the day and night engagements.

But how are motor boat flotillas to reach the scene of a battleship engagement on the high seas? They have neither the cruising radius nor the sea-going qualities to enable them to cruise with the fleet. So, if they are to get to Jutland, they must be carried there. In this respect the problem is parallel to that of the airplane which, it was known, would be a formidable weapon could it be present in numbers at a naval engagement. In the case of the airplane the problem was met by designing special airplane carriers, and in the case of the torpedo motor boat it can be solved in the same way by providing motor boat carriers. These would be unarmored cruisers about 800 feet in length and of 35-knot speed, specially built for carrying forty boats on two decks. The boats would be stowed, two abreast, throughout the full length of the ship, and electrically operated davits would be provided with gears sufficiently powerful to put the first flotilla of twenty boats in the water within a few minutes' time and a second flotilla of the same size shortly thereafter.

It is a question worthy at least of consideration, whether four such ships, taking position on the four wings of an enemy's line of battle would not constitute a more deadly threat than four battle-cruisers of the same size and speed. We do not say that they would, but we do claim that the question is worthy of the most careful consideration of our naval constructors, of our War College and of the General Board of the Navy.

Invention or Discovery

A. H. WALKER, in his standard work on Patent Law, draws a definite line of demarcation between invention and discovery. "The statute provides that patents may be granted for four classes of things. These are arts, machines, manufactures, and compositions of matter. None of these things can be originally made known by discovery, as our continent was. They are not found but created. . . . Laws of nature, on the other hand, can never be invented by man, though they may be discovered by him."

For practical purposes of patent and copyright law this distinction may be well enough. But if we love argument, we may enunciate the proposition that invention is the discovery of a fact or facts in the realm of the mind, just as geographical exploration, for example, may lead to discoveries in the realm of objective things. This may seem far-fetched, but the proposition finds support in the words of no less an authority than Emerson. For, "Poetry was all written before time was." This is not the place to quote the great essayist at length. Those who wish to refresh their memories may do so by consulting the original. Suffice it to say, that Emerson looks upon the poet, not so much as a creator, an inventor, but rather as the interpreter, the discoverer of that which existed from all time; the man whose ear is delicately attuned to the music of the spheres; whose eye is keen to discern the great truths, "which others, knowing not, pass blindly by."

We may subscribe, broadly, to Emerson's point of view, and look upon invention as the discovery that a thing can be done in a certain way, a thought expressed in certain words; and this without endorsing the insane scheme of a certain madman, of whom we read years ago, who proposed to discover all truth by writing out all words of our language in every possible combination. Some of these combinations, he said, will form sentences revealing great and new truths, and by continuing long enough we shall eventually know all truth. The reader who is mathematically inclined may amuse himself by figuring out what the probabilities are of hitting on a new truth by this method within a week, a year or a century. We recall, too, from our school days, a mechanical device, a sort of multiplication table, for composing Latin verse without mental effort. Making all allowance for the use of Roget's Thesaurus, of rhyming dictionaries and other mechanical aids to composition, it is not, of course, by any such devices as this that the great writer, or even the lesser author, makes his "discoveries." But we may liken the writer's mind to a kaleidoscope; under the stress of intense feeling (which underlies all the best in literature), the right words come to mind spontaneously, and array themselves in rhythmic cadence, as if reflected into a well ordered pattern by the facets of his mind, like the many colored prisms in the kaleidoscope, tumbling in fortuitous disorder, yet ever complementing each other, through the mirror, into a pretty geometrical design.

Electricity

An Electrically Welded Ship.—From the London *Engineering* we learn that the "Fullagar" is an entirely welded ship. The success of this ship has shown that welding is effective for all purposes in such work. It is not claimed that it is necessarily the cheapest method. The ship is one of 25,000 cu. ft. displacement.

Radio Equipment of the "Vaterland."—On this ship recently recommissioned, there are three complete wireless transmitters, one of which is worked in connection with a high-frequency generator, this being the first instance of the use of such a generator on board ship, according to *Wireless World*. For transmitting on waves of 600 to 1,800 meters, and for use with the high-frequency generator, an aerial 190 meters long is carried. For shorter wave lengths and for emergency transmitting two other aerials are provided, each consisting of a single wire spread between the funnels.

For Testing Dry Batteries.—The Bureau of Standards, Washington, D. C., has issued technologic paper No. 171, entitled "Automatic Apparatus for Intermittent Testing," which describes equipment devised to meet the needs of the bureau in making tests of dry cells and storage batteries, but is applicable to nearly any form of intermittent testing requiring the closing of electrical circuits at regular time intervals. The particular advantages of this type of apparatus for making these tests are: Elimination of rapidly moving parts, accuracy of the time intervals, and possibility of making a number of different tests simultaneously with the same apparatus.

The Printing Telegraph is being employed more and more for press news service. In fact, the American Telephone & Telegraph Company expects to change the press news service over to printing telegraph machines as fast as it is practicable to do so. For several years the company has used the printers for a portion of this service in New York, Boston and Chicago, and much of the company's inter-office communication between New York and Chicago is carried on by this means. The printing telegraph has now been developed so that, depending on the class of service, a transmitting speed of twenty to sixty words per minute can be obtained, and by means of synchronized machines sixteen messages, or eight in each direction, have been sent over one wire.

A Self-Exciting Mercury-Arc Rectifier.—A difficulty with ordinary mercury-arc rectifiers is their tendency to go out if the load drops below a certain point. There has recently appeared in Germany a new kind of "self-exciting" rectifier, which will keep going even if the load is completely shut off. The new rectifier type is of glass, quite similar to current models, but is provided with two auxiliary anodes fed from a special winding on the input compensator, according to *Elektrotechnische Zeitschrift*. The winding has a midpoint tap which is connected to the cathode, and in the auxiliary-anode connections are inserted two resisters, so that the auxiliary system forms, as it were, a small rectifier within the power rectifier. This auxiliary rectifier system takes about 100 watts, is started in the ordinary way and is always kept running. It will then automatically excite the power arcs so that the main rectifier starts as soon as the direct-current output circuit is closed, and the rectified current thus is perfectly stable down to very small current strength.

Something New in Arc Lamps.—About two years ago we had something to say regarding a novel form of enclosed arc employing tungsten electrodes and enclosed in a high vacuum, developed in England. At that time the inference was that the lamp was of a purely experimental nature, but we learn of late that this arc lamp is a commercial success. Briefly, the lamp resembles a round incandescent lamp so far as exterior design is concerned. Instead of the usual filament, however, the lamp contains a small ball of tungsten, a horizontal tungsten rod, and a small tungsten coil right over the tungsten ball. To start the arc the vacuum must first be bridged, since the electrodes are fixed. This is accomplished by passing a current through the tungsten filament which becomes incandescent and heats the surrounding vacuum. Then the current is switched over to the gap between the horizontal tungsten rod and the tungsten ball. The heated vacuum, no longer being an insulator, carries over the 110-volt current and the tungsten ball is heated to incandescence by the arc. The result is an extremely concentrated source of high candle power, suitable for numerous purposes. At present M. Belin, the inventor of the system for transmitting photographs over telegraph and telephone lines, is using such a lamp for the source of light in his receiving set. The details of M. Belin's apparatus appeared in our November 6th issue.

Science

Medical Congress in Batavia.—The Fourth Congress of the Far Eastern Association of Tropical Medicine will be held at Batavia, Java, in August, 1921, under the patronage of the governor general of the Dutch East Indies. The third congress was held at Saigon, Indo-China, in 1913.

Februaries with no Full Moon.—An English writer, Mr. S. H. Gaythorpe, has computed the number of years in the 19th to 24th centuries, inclusive, in which the moon does not become full in February. During the 19th century this occurred in 1809, 1847, 1866 and 1885. In the present century there are only two cases; viz., 1915 and 1961. In the next four centuries there will be 14 cases. "By a singular coincidence," he writes, "this happens to be of the same degree of frequency as the occurrence of five Sundays in February, though the two events are quite unrelated, the latter happening regularly thirteen times in four centuries."

Hay-fever Resorts.—In Public Health Reports for September 24, 1920, Dr. William Scheppegrell publishes statistics showing the beginning and ending of the spring and autumn hay-fever seasons in each State of the Union; the plants chiefly responsible, in each State; and a list of "hay-fever resorts" for all States where such places are known. These resorts are places that are free from hay-fever pollens, and where the hay-fever patient can find relief from the disease. As the pollen of most hay-fever plants is very buoyant and will traverse 5 or 6 miles when the winds are favorable very few places in the country are absolutely free from this troublesome disease.

A Remarkable Case of Overpopulation is that of the Island of Bukara, in Lake Victoria Nyanza, described by H. L. Duke in the *Cornhill Magazine*. This island, with an area of 36 square miles, much of which is bare granite, though isolated from the rest of the world, supports a population of 19,000. The small garden plots are carefully marked off and rights of ownership are rigidly observed. Trees are valued more than the land on which they grow. In some cases one man owns the trees and another the ground. A man must not steal his neighbor's leaves, sticks and rubbish. A father may even divide a tree among his children, allotting certain branches to each.

Guatemalan Reconstruction.—A very definite program has been prepared in Guatemala City for the reconstruction of the public buildings destroyed in the earthquake of December and January, 1918-19. Present plans call for a large amount of armored concrete construction material, of approximately 20,000 barrels of cement, with a proportionate amount of structural iron for reinforcing, and of tongue and groove lumber for flooring. In addition to the plans for the housing of the Government offices the construction of roads and highways is contemplated; also the reconstruction and increase of the water supply of the city. It is reported that an electric tramway system is contemplated, with an interurban line to Antigua, some 25 miles distant.

The American Meteorological Society, organized in December, 1919, has already attained a membership of nearly 1,000, a good evidence of the interest now taken in the study of the weather and the atmosphere by people in various walks of life throughout the country. Professional meteorologists constitute a small minority of the membership, which includes representatives of all professions concerned in any way with atmospheric phenomena, such as aeronauts, mariners, hydrologists, engineers, medical men, etc., besides the general public. A branch of the society is being organized in Brazil by the director of the Brazilian meteorological service, and a Pacific division will probably be organized next summer. The society publishes a monthly *Bulletin*, received by all members, who pay a membership fee of one dollar per annum. The secretary of the society is Dr. C. F. Brooks, U. S. Weather Bureau, Washington, D. C.

Remedies for Poison Ivy.—The *American Botanist* records that Mr. W. L. McAtee of the U. S. Department of Agriculture has collected a list of 244 alleged cures for "ivy" poisoning. Among the vegetable substances recommended to be taken internally are extracts or infusions of sweet fern, snakeroot, pasque flower, aconite, spice bush, coffee, poison sumach (!), pipsissewa, yellow jasmine, belladonna, and bryony. It is pointed out that "poison ivy probably has a reputation for harmfulness all out of proportion to its abilities; a few people are rather severely poisoned by it, but the majority seem to be immune or nearly so." We should like to add that a great deal of supposed "ivy" poisoning may be due to other plants, since there are scores of plants that are capable of causing more or less severe dermatitis in susceptible people. Copious information on this subject was published in 1887 by Dr. J. C. White in his book "Dermatitis Venenata."

Automobile

Cost of Trucking.—An Akron manufacturer running his own motor trucks between that city and Cleveland has analyzed the cost and time features of three competing methods of transportation. Motor trucks cost 36½ cents a hundred pounds, railroad freight, 80 7/10 cents a hundred; railroad express, $1.044 a hundred; and electric trolley express, 87 4/10 cents a hundred. Motor trucks costs include all direct and indirect charges. The average time for motor truck delivery is 4 hours and 9 minutes—for the other three methods, 12 to 48 hours.

Sliding Gearset Trouble.—In some transmissions of the sliding gear type the high speed or direct drive is obtained by the sliding gear, which provides the intermediate speed having a suitable extension from its face designed to mesh with an internal gear, and thus form a positive driving clutch to couple the gearset main shaft portions together. When the teeth on the male clutch member become worn considerable trouble will be experienced in securing positive engagement, and if the wear is such that the width of the teeth is materially reduced a new member will be needed. If the teeth are not worn, but are only turned over at the edges, they may be dressed to proper contour by using a very small, high speed emery wheel on the end of a flexible shaft or by removing the offending member and grinding it in any suitable machine.

Commercial Motor Truck Exports Reflect Healthy Market Condition.—Exports of commercial motor trucks from the United States for the months of October, November and December of 1919, and for January and February, 1920, are represented by the following figures taken from the reports of the Bureau of Foreign and Domestic Commerce:

Month	No.	Value
October	1,301	2,031,204
November	1,712	3,143,351
December	1,465	2,495,685
January	1,721	2,727,856
February	2,889	4,130,468

By far the greater number of motor trucks went to France, England and Canada, the remainder of the exportation being divided between over one hundred other countries. It is expected that later reports will indicate a similar ratio of increase.

Tractors Popular in France.—French agricultural experts and M. Thoumyre, under Secretary of State for Agriculture, announce the prospects for the wheat crop in France this autumn are excellent, according to the *London Mail*. More land has been put under cultivation and with the use of fertilizer and motor traction it is hoped that French soil will this harvest suffice to produce nearly all the corn needed for next year's consumption of bread. According to the official figures of the French Department of Agriculture this year five million hectares or over 12,350,000 acres of land have been plowed and sown with wheat. This should produce at least seventy million quintals of wheat, leaving about ten million to be imported. Last year the home crop was so small that more than thirty-five million quintals had to be imported. This bumper wheat crop is expected to save France the huge sum of six and one-quarter milliards of francs (one and one-quarter billion) and thus cause a considerable improvement in the value of the franc.

Have Steam Cars a Future?—Among pioneer motorists there have always been numbered a few enthusiastic supporters of the steam car. Despite the gradual disappearance of the steam car, that interest still exists, and it needs but the slightest encouragement to make itself manifest. Although the internal-combustion-engined passenger car seems to have ousted its rival—for only in the United States is the steam car still manufactured—yet recent developments in steam engineering, such as the oil-fired steamships and locomotive engines, suggest that were the steam car reintroduced on modern lines it would prove vastly superior in efficiency to its predecessors. At the present time the rising price of gasoline is focusing attention on alternative fuels, and it must be remembered that the steam car presents another method of utilizing kerosene and even crude oil as fuel. If we concede that a heavier grade of oil fuel than kerosene even, might be utilized in the light of experience gained from oil-fired furnaces, then it is conceivable that the steam car might be in a better position than formerly to compete against cars engined with internal combustion motors. This is, however, rather in the nature of conjecture, and we do not wish to raise false hopes in the breasts of the steam car enthusiasts as only one company is producing these cars on a really commercial scale. Others have been formed but the production has been limited to a few experimental models.

Something Different in Salvaging Operations

Relieving a Wreck of Its Cargo with the Aid of Injections of Compressed Air

By Robert G. Skerrett

IT is the unique thing in salvage procedure that makes it plain that the more or less deeply sunken craft is no longer a wreck to be classed off-hand as a total loss. Similarly, these occasional evidences of engineering resourcefulness show what the scientific mind is doing in the way of revolutionizing this department of human effort. And what is equally significant is that the skillful application of the force and buoyancy exerted by compressed air is making these advances possible. Probably no example of this is more instructive than the work recently done in raising and freeing the freighter, "Canadian Recruit," from a very difficult position.

The ship, a steamer belonging to the Canadian Government, sailed from Quebec in the latter part of December a year ago, and on her way seaward had to contend with heavy ice. As a consequence of her struggle to get clear she lost her rudder and was driven ashore. In the months that followed, the floes, impelled by the tides, shifted the vessel, and at the same time cut away the river bed under her stern, causing the ship to settle deeper there. She finally came to rest with her after deck 29 feet below the surface at low water and listed over to port at an angle of 18 degrees.

The run of wreckers along the St. Lawrence looked upon her recovery as exceedingly doubtful, but one concern having affiliations with United States experts essayed her refloating on a "no-cure, no-pay" basis. To make the problem harder, it should be pointed out that the steamer was stranded forward in shoal water, and she carried a general cargo which substantially filled her several holds. The "Canadian Recruit" is 250 feet long, has a beam of 43.5 feet, and a depth of 26 feet—a sizable craft.

The ship was hard and fast on Mille Vaches Shoals, where the tides run very strong and have a rise and fall of many feet; and to add to the difficulties the steamer lay in an exposed position with comparatively little water around her forward end for the prosecution of wrecking operations. Her release was primarily contingent upon the removal of much of her freight; and the nature of her cargo was such that it was well worth reclamation. Not only that, but because the stuff stowed aft was made up in part of many cases of glass bottles, ordinary dredging facilities could not be employed to clear the submerged hold. That is to say, had clam-shell buckets been used the bottles would have been smashed, and broken glass would have imperilled the divers at every step. Besides the boxes of bottles, the after cargo space held several hundred bales of hay, some tons of cement, more than 2,000 pieces of heavy lumber, and quite 8,000 bags of flour, rice, and malt.

The first problem was to get out the lumber and the flour, both of which floated and handicapped the divers continually; next it was essential to success that the rice and malt be sent up to the surface; and then, with the way cleared, the menacing glassware was carefully hoisted from the hold. And now we come to the first of the novel expedients resorted to in dealing with the problem. The flour, owing to its buoyancy, crowded upward in the cargo space and packed itself tightly in the upper section of the hold on the higher or starboard side and well above the lower projections of the hatch coamings. It was out of the question for the divers to pull these bags down several feet and shove them into the hatch openings so that they might rise thence to the surface. Accordingly, compressed air was fed into the upturned area in sufficient quantity to force the water level lower, and this enabled the divers then to push the bags of flour with comparative ease into the hatchways—their buoyancy serving to complete the rest of their journey upward.

But the malt and rice did not lend themselves to the same solution. Each package of malt weighed something like 200 pounds, and was held in two bags—the inner one being of a more closely woven fabric. Let it be recalled that tidal conditions were so troublesome that divers could work during the day but a maximum of four hours just before and after the slack of low water; and from their very nature the bags of malt and rice could not be dealt with quickly and in considerable numbers within so brief a span unless means could be devised to make them easier to move from where they were stowed to points vertically in line with the uncovered hatches. This was achieved by giving the bags, so to speak, hypodermic injections of compressed air—enough of this air being retained in the mass to make it slightly buoyant. In this condition the malt and rice could be shifted to positions whence they would float free to the surface. The "needle" for this work was fashioned of a short length of brass pipe pointed at the outer end so that it could be jabbed deeply into the package of malt or rice. The apparatus was fitted with a valve, and was connected to an air-supply hose. The double bags enveloping the malt and the glutinous condition of the wet rice immediately next to its container tended to confine the air for a while.

By reason of skillful use of this ingenious makeshift, this part of the cargo was disposed of rapidly. How thoroughly the men did their work under water is evidenced by the fact that when the "Canadian Recruit" was refloated only four bags out of a total of 4,500 remained inside of her.

With her after hold cleared and some of her cargo taken out forward—a considerable amount of it had to be left in to insure the craft's stability when again becoming water borne—the salvors displayed their highest skill in bringing the submerged after body up. The fore-and-aft trim of the steamer, her marked heel to port, the depth of water over her deck under the most favorable condition, and the sweep of strong currents made it impracticable to have recourse to cofferdams reaching from the hatches up above the surface of the St. Lawrence. There were no lifting vessels to be had capable of bodily raising the dead weight involved, even if wire hawsers could have been got under the wreck; and to seal her hatches and pump her cargo space full of compressed air was deemed too risky—the wreckers fearing that the expansion of the confined air, as the boat rose surfaceward and the hydrostatic pressure dropped, would blow up her decks unless rather complex measures for the relief of the air could be installed.

The means finally adopted were two steel trunks—really great metal boxes devoid of tops and bottoms, and fashioned large enough to slip freely into the two rectangular deck openings. At the top of each trunk there was attached a wide projecting brim or collar, and this had spread enough to reach beyond the hatch coaming. On the under side of this brim was secured a white pine plank, 3 inches thick, and upon this yielding material the trunk settled against the hatch coaming and was drawn tight by numerous hook bolts—thus providing an air-tight seal. The diagrams accompanying this article show how the trunks reached deep into the hold and were, in effect, in-turning bottle necks.

Their purpose was to permit the cargo space to be filled with buoyant air under pressure and yet to supply a medium for the automatic release of that pressure in a way that would not endanger the hull structure as the steamer lifted clear of the bottom—in short, to act as an elastic cushion capable of equalizing and balancing the opposing air and water columns.

Two channels were used for distributing compressed air in the after hold. One was a connection, made through the deck, to which hose was attached, and the other was a metal pipe, having an upturned or hooked

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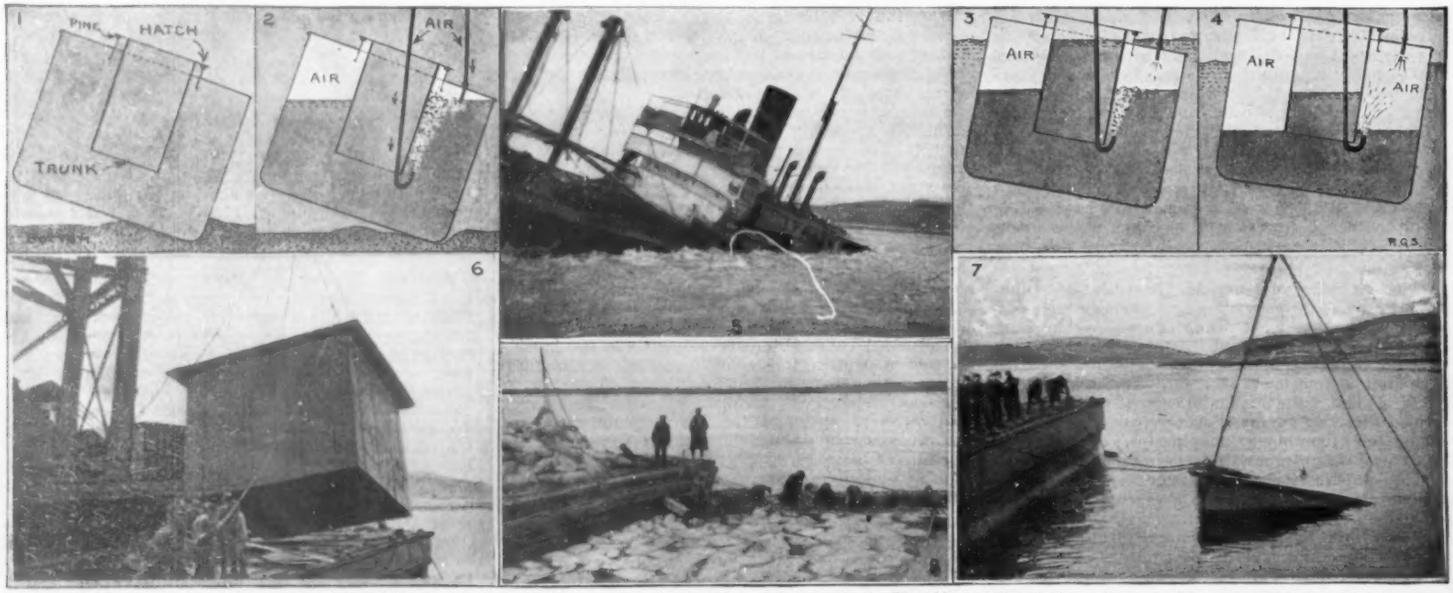
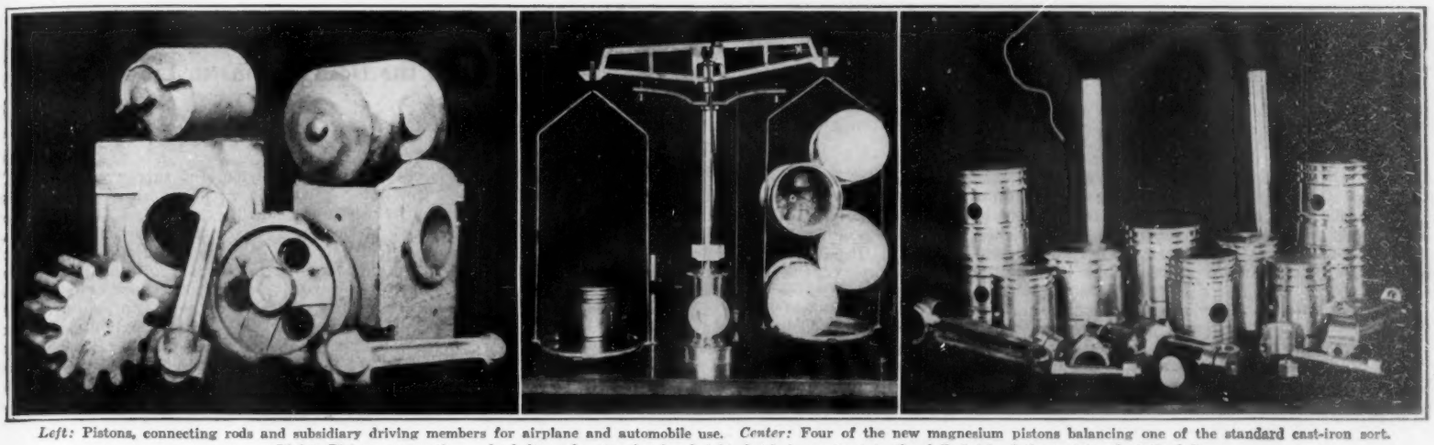


1. Original position of ship, showing a trunk installed. 2. Admitting air to cargo space to start the vessel upward. 3. The ship arriving at the surface. 4. The craft just before attaining the maximum buoyancy imparted by the compressed air. 5. "Canadian Recruit" at low water. 6. One of the trunks being loaded for transportation to the wreck. 7. A trunk being lowered into position in one of the hatches. 8. Impounded bags of malt and rice brought to the surface by hypodermic injections of compressed air.

Some of the unusual details of the salvage operations on the "Canadian Recruit," ashore in the St. Lawrence and for many months at the mercy of wind and tide



Left: Pistons, connecting rods and subsidiary driving members for airplane and automobile use. *Center:* Four of the new magnesium pistons balancing one of the standard cast-iron sort. *Right:* Pistons, connecting rods, bolts and nuts, showing bright finish in contrast to the dull finish of those pictured at the left

Some of the ways in which the new alloy of magnesium is used for automotive parts

A New Magnesium Alloy for Motor Pistons

By George Gaulois

A NEW alloy of magnesium has appeared which is offered as the lightest metal to be used for pistons for automobile or airplane engines. It is the lightest metal known which is adapted to commercial uses. Magnesium constitutes ninety per cent of the alloy which differentiates sharply between this new alloy and other light alloys on the market which are made up mostly of aluminum and contain magnesium only in small quantities if at all. Some of the striking quantities of the new alloy, Dow metal, are due to the presence of magnesium which is the lightest metal possessing high tensile strength and physical properties rendering it suitable for engineering uses.

This new alloy has been brought to the attention of engineers within the last year. Prior to the war, magnesium was imported from Germany and its main, if not sole use, in the United States was as a deoxidizing agent for non-ferrous metals. The new alloy is one-fourth the weight of cast-iron and one-third lighter than aluminum. When the foreign supplies were cut off early in the war, the manufacture of metallic magnesium was undertaken at Midland, Mich., there being unlimited amounts of the raw material in the brine pumped from the numerous wells there, from which many other chemical products were manufactured. Among these manufactured products is the salt, magnesium chloride, which after suitable preparation is used for the manufacture of metallic magnesium. The process employed is electrolytic in which a heavy direct electric current is passed through a molten salt bath, maintained at a red heat until it is decomposed by the current and the metallic magnesium is formed which, on account of its extreme lightness, rises to the top, floats on the surface of the molten bath and is skimmed off from time to time.

In the past the demand for magnesium was limited, because no alloy of it had been discovered which possessed the mechanical properties necessary for its use in practical construction of the parts in automotive and aircraft production. But after much experimenting and after many tests, the present alloy was obtained. The main use found thus far has been in the manufacture of pistons for automobiles and airplanes, as well as motor boats. Possessing a tensile strength of from 22,000 to 25,000 pounds per square inch, it is also the lightest material used for such purpose, besides having no abrasive or scoring action on cast-iron cylinders and having approximately the same coefficient of expansion as other light piston alloys. This metal differs from aluminum as to the expansion under heat in a motor in that there is no permanent growth or set at these temperatures. Recent tests have shown that with 21 successive heats made for two hours each and for 0 to 800 deg. F. the permanent growth is so minute that it cannot be detected with a micrometer.

In machining no cutting compound is used and with the lathe running at the highest speed, there are no hard spots. Great resiliency is shown by recent tests at the Government laboratories at the McCook Aircraft Field, Dayton, Ohio, in which a piston was placed in a vise and forced in one-fourth inch and, upon being released from the vise, came back to size with the exception of being only 0.004 inch out of round.

The table gives the important physical properties:

Specific gravity	1.79
Tensile strength, lb. per sq. in.	22,000 to 25,000
Yield point, lb. per sq. in.	12,000 to 14,000
Compressive strength, lb. per sq. in.	45,000
Elongation, 2 in., per cent	3.5
Reduction in area, per cent	3.5
Modulus of elasticity	9,000,000
Brinnell hardness	55 to 75

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A Giant Ingot-Mold Casting in the Making

By A. R. Surface

ALL steel when made in any kind of furnace or by any process is poured into some kind of a mold. If the steel is later to be forged or rolled into some kind of shape it is poured into iron molds called "ingot molds." If it is to remain as a casting and used in the form in which it is poured or cast, it is poured in a sand mold and when cool, shaken out as a finished casting.

For some special forgings very large ingots of steel are required. This applies usually to large marine engine forgings or to propeller shafts, etc. Such an ingot mold for such a purpose and its method of manufacture is represented by the illustrations. It is of unusual dimensions and weight and its pouring and molding involved difficult problems, particularly as regards the core which forms the hollow part of the ingot mold and which corresponds to the steel ingot that is desired.

In order that a thoroughly sound casting might be obtained, it was poured on end. To accomplish this, the mold in which the casting was made was erected in a molding pit extending 14 feet below the floor level. Due to the fact that water is reached at 8 feet below the floor line, it was necessary to make this molding pit absolutely water tight. In pouring castings of this character on end, it is necessary to cast large risers or headers on the casting, so as to provide a quantity of metal upon which the casting itself draws as it cools, thus filling up holes caused by contraction. An experienced foundryman will appreciate the difficulties encountered in pouring on end a casting of this weight and character.

One of the important requirements was that the diameters of the mold should be the same at both ends.

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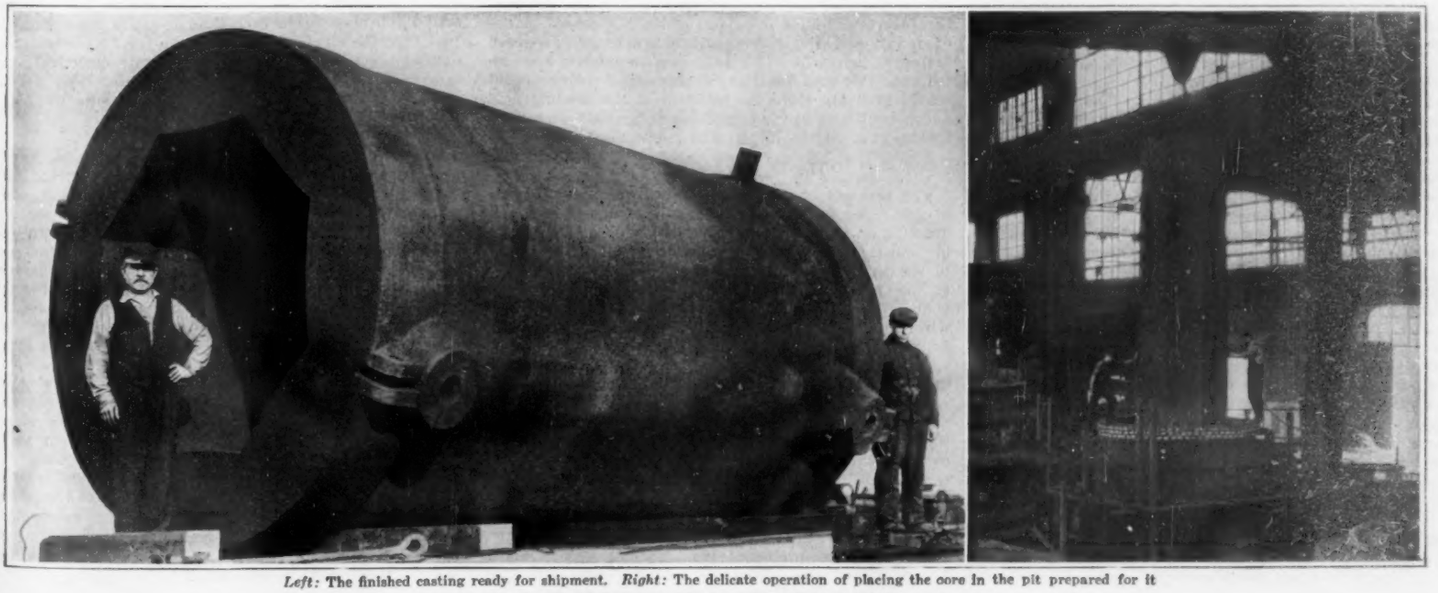


Left: The finished casting ready for shipment. *Right:* The delicate operation of placing the core in the pit prepared for it

How a giant ingot mold of steel is cast on end in a pit

Aircraft of the Future

A Statement of What Remains To Be Done, and the Directions in Which the Doing Seems to Lie

By C. H. Claudy

ACCORDING to their advertisements you can, for a dollar, get a "crystal reading" or a "spirit prophecy" or a "delineation of your future" from dozens of "mediums." According to universal human experience, prophecy goes wrong more often than it comes out according to specifications. So let it be said at the outset that this "delineation of the future" of the airplane is not intended as a prophecy but as a sober exposition of possibilities, based on a statement of the unsolved problems in aeronautics as formulated by no less a body than the National Advisory Committee for Aeronautics, instituted by Uncle Sam and transmitted in the form of an elaborate report to Congress by President Wilson.

If the future ever is foretellable in the way which will have credence from men of science, it will be merely as we foretell eclipses of the moon—by a thorough knowledge of the laws governing the phenomenon. It is a familiar truism that the unsolved problem of today is the commonplace of the morrow, always providing that the unsolved problem has a sufficient demand for solution to interest brains and money in its solving.

In spite of the fact that the United States is woefully backward in all that appertains to aviation, the world has demonstrated that the art of flight has come to stay and is to play a great part in peace as well as in war. The stern necessity to solve the unsolved problems of today will as inevitably solve them, as stern necessity devised the audion, ductile tungsten, the X-ray and a thousand other marvels. Simon Newcombe demonstrated mathematically that man could never fly a heavier-than-air machine. It was accepted as an axiom that the composition of the stars was unknowable—until Fraunhofer came on the scene. Always, when the demand has been great enough, we have solved our problems. To state, then, the problems yet unsolved is to foretell to some extent what the future may be.

With What Shall We Build?

The committee lists as the first outstanding problem in airplane construction the matter of material. It lays down this as axiomatic: "We may, however, be well assured that however good may be any solution we may reach of the many problems presented to us in the industrial arts, there are, as a matter of fact, series of better ones only waiting our patient study." In other words, no matter how skilfully we use wood or metal or wood and metal to make a skeleton and fuselage, there are better ways and better combinations possible, and unknown possibilities in the use of new alloys, and some of the new steels of unheard of strength for their weight. That the optimum construction even with present materials has been reached is not admitted by the committee; that untouched fields in materials, forms, and combinations lie waiting the investigator is stated as a fact. It can then be predicated upon the whole history of construction of other bodies which must at the same time be strong and light, that the airplane of the future will be in all probability built of metal rather than of wood, and that its strength will be no less in proportion to its weight than today, and probably much greater.

The problem of materials is so closely bound up with the problem of size that the two can hardly be considered apart. The committee asks of size "Is there a limit? If so, what is it? Why is it? And how may it be removed or extended?" and then proceeds to answer itself by stating the factors of the size limit as we know them today. Weight increases as the cube, while areas of supporting surfaces increase as the square, or dimension. It seems obvious enough, then, that taking any given speed of plane and size of power plant as a standard, there must come a point when the whole cannot be made larger without becoming too heavy to fly.

The Problem of Size

Yet these same laws obtained when Wright first flew in a forty-foot plane, and when the huge Capronis of today were not even dreamed of. We have escaped this law so far and there seems no reason to think we may not continue to escape it. We escape it by the simple trick of not enlarging our planes as a whole. We do not make a big plane line for line like a small one. We do not have to make a large wing geometrically similar to a small one. We can lighten as we enlarge; lattice takes the place of solid, tube replaces rod. Moreover, the wing, which supports, weighs least of any of the three great members of a plane—wing, fuselage and power plant. We may extend wing area and get increased lift without even squaring, let alone cubing, the weight—if we can engine the whole. If we can master the aerodynamic problem of multiplying wings without interfering the one with the other, there may be no limit to the size of our future planes.

We can safely prophesy, then, that when the demand comes for a huge plane, capable of carrying not its tens and twenties but its hundreds of people, not its ton or ten tons but perhaps its hundreds of tons of weight, there is no structural or scientific reason why that size should not be had. In other words, the plane of the future will be to the plane of today what the "Leviathan" of the sea of today is to the "Clermont" of yesterday.

No one familiar with airplanes of today who knows that as speed increases wing areas diminish, and that as wing areas increase speed diminishes, but understands the real need for some practical plane of wing-area variation during flight. A very high-speed machine is a dangerous thing when it comes to landing if the field is not huge and smooth, because it must land at high speed. A plane that lands safely on fairly rough ground can accomplish little in speed. Either variable areas or variable camber (curvature), or both, may easily be accomplished upon the designer's board or in model form, but so far no wholly practical solution of the problem in actual machines has been attained.

SCIENTIFIC prophecy is frequently referred to as a very dangerous game. Under some circumstances it is dangerous enough, for, as we have recently pointed out, if the scribe knew the direction in which the ship of discovery ought to be piloted for greatest success, he would be at the helm instead of on the dock awaiting her return. But Mr. Claudy exhibits the other side of the picture when he reminds us that in many cases a mere statement of the problems unsolved is apt to be a pretty definite forecast of the direction to be taken by the effort at solution. Especially is this the case in an art so definitely mechanical as that of flying. So we feel that Mr. Claudy's remarks should perhaps be taken a little more seriously than we are accustomed to take the scientific prophet. The airship of the future must exhibit many of the features which he suggests.—THE EDITOR.

It seems obvious, therefore, to say that the plane of the future will have the speed of the high-speed planes of today and the safety and slowness of low-speed planes of today, at will. Indeed, a completely successful variable-area and variable-camber wing outfit would probably solve the problem of the landing field and permit landings in small spaces, perhaps even upon the roofs of city buildings, and yet with safety.

The Engine and the Fuel

The problem of motive power is in a constant state of flux. No consideration can be given to it without drawing an immediate dividing line between the probable and the possible. The probable power of the future in the light of the present is an internal combustion engine presumably burning gasoline or other light volatile liquid. The possible powers are numerous—wireless power, electric power, liquid gas power, high-explosive power, steam power, bithermal power—all these are possible in the sense that they are yet largely untried. The committee confines its attention to the probable development of existing airplane engines, and lists among the main outstanding engine problems the problem of fuel, the problem of how much power to an engine, of how powerful a power plant may be, the carburetor, of ignition systems and of maintenance of power at high altitude. The committee finds that the present-day refined motor fuel for aviation engines nearly approaches the ideal; "a long look ahead shows that a serious problem must be met before many decades," and the committee makes no suggestion in regard to what will happen "when present petroleum sources will no longer yield the supply we now use."

"How much power can we put in an airplane? How much power from a single cylinder? A single engine? A single airship?" The committee sees nothing in the way of multiplication of cylinders in one engine up to eighteen, and nothing in the way of multiplication of engines even beyond four. It does not believe much more than forty horse-power per cylinder can be developed along present lines or that cylinders can become much larger but figures that if a 2,500-horse-power power plant is called for, it could be designed (several engines) and that even larger collections might be possible. It defines the limitation largely as a problem of cooling, but it seems safe to state that the airplane of the future will have all the power it needs unless, indeed, its needs become Gargantuan beyond present-day visions of possibilities. None foresaw the enormous horse-power of ocean vessels of today when steam was first applied to ship, or of locomotives when the Rocket first puffed her uneven way, or of automobiles when Daimler first chugged in his one-lung vehicle.

Mixing the Fuel and Touching It Off

The carburetor is still an unsolved problem for the automobile; much more so for the airplane, which changes its level by thousands of feet. That the airplane of the future will be independent of pressure and chemical-constitution-of-the-air variations due to altitude seems unquestionable. Whether by forced air feed or an oxygen tank or some other method must be left to the future to decide. Whatever the solution the carburetor of the future will function as well at high altitudes as at low ones, will supply an even mixture for each and all of any multiplicity of cylinders, and an even quantity of mixture to each cylinder, will not be affected by changes in inclination and will be accident-proof, that no failures occur in mid-air.

Ignition is still a problem, strange though the word sounds to those who marvel at the perfection of generator, battery, magneto, wiring diagram and spark plugs of today. The committee says: "If we can anticipate the explosion engine of the year 1970, assuming that our grandchildren are still dependent upon hydrocarbon fuels at that date, it would seem as though some more simple and direct mode of initiating the combustion in the cylinders would have been found. On the law of probability the chances are overwhelmingly against our having at the present moment developed the very best method of ignition." This would seem to presage some sort of thermal tube, or even ignition by compression, *à la* Diesel engine, but the present scribe ventures no further than to state the apparent fact that the airplane engine of the far future will not depend upon a complicated and delicate electrical system to fire the charges in its system—at least not if careful research can find a better and simpler way.

Divorcing Power from Altitude

An airplane normally loses horizontal speed as it ascends to higher altitudes. The reason is in the one factor which remains fixed while everything else changes with altitude. That one factor is the weight which, while it does change mathematically with removal of the mass from the center of the earth, does not change practically. While decreased supporting power of the air (due to its rarity) is compensated for by decreased resistance as far as headway is concerned, it is nevertheless true that the weight, remaining the same, must be kept up in the more rare medium by a greater angle of attack of the wings upon the air, which, drawing from a fixed amount of power, requires more power for translation into weight support and leaves less for propulsive effort. Moreover, while the same amount of cubic-inch displacement remains in each cylinder regardless of altitude, what goes into the displacement is less and less as altitude gets greater and greater. The plane which is normal-powered for low altitudes is under-powered for high altitudes. That some solution will be found, either in design or in the use of air compressors, seems obvious. Certainly the airplane of the future is not to be handicapped by

(*Continued on page 532*)

The Five States of Matter

Two Fundamental Conditions That Must Be Recognized, Besides the Solid, Liquid and Gaseous

MATTER may be defined as that which occupies space, possessing therefore comparative weight. This definition does not denote the physical characteristics of matter, but it is now generally conceived to be capable of existing in five specific forms, each having its own characteristics but capable of assuming the characteristics of another state under certain definite conditions.

The physical properties of three of the five states of matter, namely, the solid, liquid and gaseous, are so well known that only a concise mention need be made concerning them, says the *Bulletin* of the International Metallurgical and Chemical Society. Regarding the other two states, radiant and ionic, less is known concerning their physical identity and characteristics, so that it becomes necessary to study them through the phenomena that they are capable of exhibiting, and not through themselves. This may seem strange to say, or it may appear contradictory, insofar as previously stated that matter must have weight, whereas we cannot study radiant and ionic matter directly, but through the characteristics that they possess. When studying electricity, we do not study it directly, but study the effects of it.

The most recent investigations and researches dealing with the nature of matter, point in the direction of the electrical identity; that electrical charges, both negative and positive, are the cause of and constitute all matter. Now matter must possess weight (truly), so that if matter is composed of that phenomenon known as electricity, why, the source of it must possess weight in the first place. Briefly stated in the words of that great scientist, Benj. W. Sands, "what equals one thing must equal another." If the essentials of the electrical theories of matter are held as probable (and there is no doubt but what they are as reasonable expositions of matter as the accepted atomic and molecular theories), the relation and interrelation of the various states can be readily accounted for, together with the correlation of energy and many other phenomena which previously were considered complete or veiled mysteries.

The importance of a thorough investigation and understanding of matter from a chemical aspect cannot be overestimated. First, chemistry is the science which deals with matter (the elements, their compounds, mixtures and characteristics); in the second place, chemical reactions and interreactions can account for many of the phenomena which formerly were considered purely physical; then in the third place, in order to understand energy and the correlation of the forces, it is necessary that a solid foundation be established concerning matter, and its cause. When one fact concerning matter or its cause is firmly established, we have a basis from which to work and investigate further.

Solids.—A solid substance is a body at ordinary temperature and pressure which can retain its original shape to a limited extent.

"A solid is a body which, at ordinary temperature and under slight pressure, does not change its shape." —Hoadley.

Liquids.—Liquids or fluids are bodies which, upon slight pressure upon the surface, give way in the immediate vicinity. Liquids have definite size, but they take the shape of the container and have a free surface.—Carhart-Chute.

Gases.—Gases are bodies which are in suspension, being neither solids nor liquids. Gases possess some of the qualities of both solids and liquids; *i.e.*, they cohere, and give way under pressure.

A gas is a body whose internal forces do not constrain it to assume any definite volume or form. It expands in all directions. . . . When confined in a closed vessel, it exerts pressure upon every part of the surface which envelops it.—Magie.

Radiant.—Radiant matter is that which is existing capable of being transferred from one substance to another, or being condensed and focused. Light and heat are the two most common occurrences of radiant matter. Of course the argument that is still advanced that light is not heat, may be considered, but the fact that radiant heat traverses space with the same velocity as light tends to disprove that theory, so that with great probability, if not certainty, light and heat may be considered radiant matter or varieties of it.

One of the characteristics of the radiant state is that it is capable of passing through certain substances without being perceptibly absorbed. This is not a true scientific statement, insofar as probably there are no bodies that are perfectly diathermanic.

Ionic.—Ionic matter is capable of being transferred through space without changing its natural state. It is capable of existing anywhere and might be termed etheric or kinetic matter. It is the unity atom, potential matter, or the protyle of Sir William Crookes. It is the cause of the evolution, or genesis, of the elements, together with its accompanying phenomena. It is the electrical phenomenon responsible for all matter.

It differs from the other four states, as it is invisible, so indefinitely small that it possesses the property of being able to penetrate all other matter, but still so great in latent properties that under certain conditions it is responsible for other conditions and states of matter.

As is noted, the differences between the five states of matter are very indefinite, in fact, so obscure that they terminate into each other. It is similar to those (literal) changes of matter which some state are physical and others chemical. However, when the true nature of these changes is understood, it is probable that it will be able to account for these properties.

In studying the states of matter, the idea of the law of periodicity or the cycle law, such as has been demonstrated by Mendelieff and Meyer, in the formulation of the periodic table through the grading of atomic weights, and by Sir William Crookes, through his differentiations of protyle by means of the vibration frequency and space of the hydrogen atom, has been forced to be taken into due consideration. To illustrate the law of periodicity or scientific equality, if the ionic state of matter is responsible for the radiant state, the radiant for the gaseous state, the gaseous for the liquid state, the liquid for the solid state, could not this process be reversed when the last named state is reached and it be responsible for the ionic state, therefore a cyclic process? Or upon the hypothesis of Sir William Crookes, the unity atom being hydrogen (?), the differentiation of the elements and its various states can readily be explained.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Power from the Thermocouple

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed in several recent issues of the SCIENTIFIC AMERICAN and of the SCIENTIFIC AMERICAN MONTHLY articles relating to the approaching time when our visible fuel reserves will be exhausted. One article in particular whose title and author I do not remember, mentioned the sun, the tides, the internal heat of the earth, the wind and water power as being sources from which we can draw our power and heat in the future.

We all know of the experiments which have been conducted in Egypt and elsewhere in the generation of steam from the ordinary heat of the sun concentrated by mirrors or lenses upon a boiler. The chief difficulty of this lies in its inefficiency and in the large and expensive layout necessary in proportion to the power secured.

It has frequently occurred to me that the principle of the thermal couple could be utilized to advantage in turning the sun's heat directly into electric current, eliminating much of the heavy complicated machinery now necessary to do the work.

The thermal couple as it now stands is of course extremely inefficient; though I do not think it is more so than were the earliest motor generators; and it would probably not be impossible to develop it to compare favorably with motor generators of today in efficiency. It is at any rate a promising field for research and experiment. A large number of such couples could be connected in parallel, the joints being flattened to receive the sun's heat from a wider area and sheltered from wind to prevent any cooling effect. The cooled joints might be buried deep in the earth or cooled by running water or in any of a variety of ways. Extensive plants could be erected on the deserts of Nevada and Utah and current transmitted on high tension lines to neighboring cities. Or it might be that Marconi's suggestion of wireless transmission of power could be developed so as to be used to advantage.

At any rate there is approximately a horse-power in sun's heat going to waste on every square yard of that desert country, which would be well worth going after.

In regard to the use of the wind as a source of power the writer of the article above referred to made the objection that a windmill which is strong enough to stand up against heavy gales is too cumbersome to be moved by light breezes. While this is perfectly true of the ordinary type of windmill it is still possible to construct a wind-power machine which is neither too heavy for the lighter breezes nor too weak to resist the heavy gales. I know of two general types of machine which would satisfy these requirements, one being on the order of the centrifugal blower which is used to ventilate our large industrial plants, the other being in the form of a helical screw upon an axis fixed in a tube with a flaring mouth to concentrate and increase the velocity of the wind in the tube. This flaring mouthpiece could be used upon any type of wind machine and would have the same effect of an increased diameter of wheel without adding to the weight of the moving parts. Automatic arrangement could be made whereby it would be removed or rendered non-effective when the wind reached a pre-determined velocity. There are a number of other ways in which a battery of wind machines could be regulated so as to produce a fairly constant current.

These are suggestions which may be of interest to any of your readers who are equipped for research work along these lines.

New York. LEO G. HALL.

Two Problems That Are With Us

To the Editor of the SCIENTIFIC AMERICAN:

I have been very much interested in the Einstein theory, but have not been able to learn much about it except through a few popular articles that were not written by any of the famous twelve. I hope that in the articles that I understand you are going to publish on this subject that you will not bury the facts under the mass of glittering generalities that befog most "popular expositions."

This seems to me to be a suitable time to add a few remarks to the many that have already been said about Mars. Starting from the supposition that the inhabitants of Mars differ from us no more than the Chinese do, there would still be no possible way to prove that any signals that might be exchanged were the result of intelligence and not the accidental working of nature. The only way communication can be established that would defy argument would be for some person actually to visit Mars, the arrangements for the trip being under the auspices of some institution whose prestige would be a guarantee against trickery. Such a trip is not impossible but the difficulties in the way would probably prevent its accomplishment at present.

Camp Lewis, Wash. CAPT. A. R. ROCKWOOD, C.A.C.

Twins

To the Editor of the SCIENTIFIC AMERICAN:

In discourses on heredity I have often seen it mentioned that the tendency to have twins is hereditary, or "runs in families"; but there is what appears to be another fact regarding the twins tendency that I have never seen in print and hence doubt that scientists have noted it. This fact is, that the mother of twins will almost always be found to have had an unusually large number of brothers or sisters or both; while the father in a good many cases may have had but few or none. As local registrar of births and as a member of this community for many years, I have been unable to find a single instance in which a mother of twins did not have at least five and sometimes about ten brothers and sisters. This I think could hardly be mere coincidence, and I ask that scientists look into the matter, for it is something that could be easily proved or disproved.

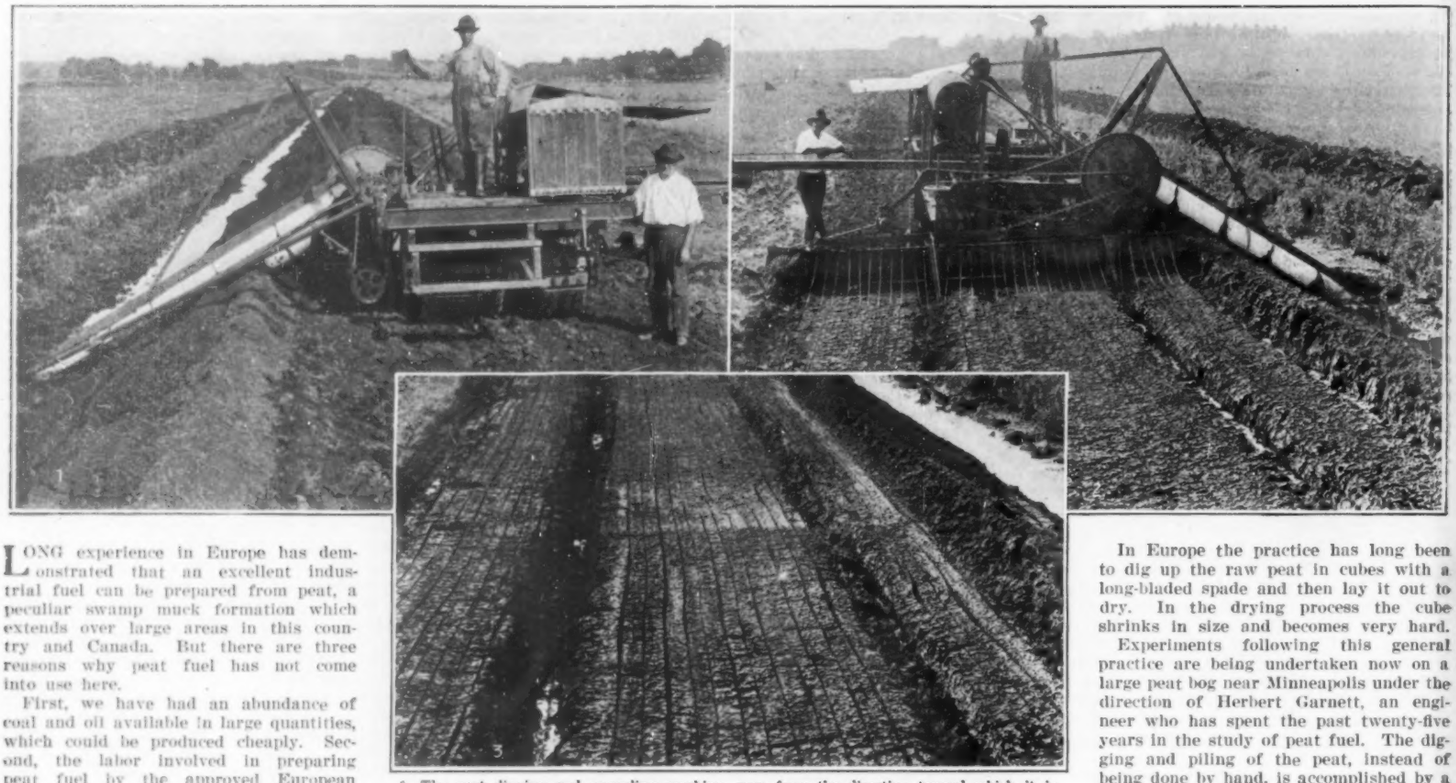
Livermore, Cal. ELMER G. STILL.

[We know one case where the mother of twins is herself one of five; but this is hardly enough to throw Mr. Still out of court. If any reader wishes to put other cases before Mr. Still the printed address will reach him.—THE EDITOR.]

Our Coal in the Making

America's Peat Bogs and Their Utilization for Fuel

By Harry A. Mount



1. The peat digging and spreading machine, seen from the direction toward which it is progressing. 2. Another view of the machine, from behind, showing the cutters that leave the peat in strips. 3. The bank of peat left in the wake of the spreader

How peat is being taken out of Minnesota's bogs by machine

LONG experience in Europe has demonstrated that an excellent industrial fuel can be prepared from peat, a peculiar swamp muck formation which extends over large areas in this country and Canada. But there are three reasons why peat fuel has not come into use here.

First, we have had an abundance of coal and oil available in large quantities, which could be produced cheaply. Second, the labor involved in preparing peat fuel by the approved European method makes it impractical for adoption here. Third, we have lacked adequate machinery for easily converting large quantities of peat into fuel.

As a natural result of these, might be added a fourth reason. Our industrial engineers know little or nothing of the properties of peat fuel and the "technique" of its use has yet to be developed.

The real reason, of course, is our hitherto "inexhaustible" supply of coal. But hardly a day passes now that we are not presented with some new evidence that our coal supply is far from being inexhaustible, and indeed our present supply barely can be stretched to meet our increasing industrial needs. And so our engineers have already turned their attention to peat and the limited development which has taken place holds the promise that before many years we may expect to see our 12,000 square miles of peat deposits supply fuel for many of our factories and utilities, and even our homes.

The files of our patent office bear witness to the fact that many attempts have been made to manufacture peat fuel by a purely mechanical process. These have all been failures because of the nature of the raw peat, which was not thoroughly understood.

True peat is really coal in the making. It consists of age-old deposits of ferns and water plants which have gradually built up a lake into a swamp. The deposit consists largely of partially decayed water plants, which naturally have a large affinity for water.

Raw peat may contain as high as 90 per cent moisture and so far every effort at mechanical elimination of this water has failed, from a commercial standpoint, due to the fact that about 60 per cent of the moisture is held in chemical combination or in minute cells.

The water can be eliminated in mechanical dryers, but more fuel is required to drive off the moisture than the finished product furnishes. Only a small part of the water can be forced out under the most powerful hydraulic press.

The most successful method of elimination, and that used most widely, is the ordinary process of sun drying. About ninety days, however, are required to dry the peat to 20 per cent moisture, when it is suitable for fuel. Operations, moreover, are necessarily restricted to the summer months and to dry weather.

In Europe the practice has long been to dig up the raw peat in cubes with a long-bladed spade and then lay it out to dry. In the drying process the cube shrinks in size and becomes very hard.

Experiments following this general practice are being undertaken now on a large peat bog near Minneapolis under the direction of Herbert Garnett, an engineer who has spent the past twenty-five years in the study of peat fuel. The digging and piling of the peat, instead of being done by hand, is accomplished by a specially designed machine, photographs of which are shown herewith.

The machine digs to a depth of seven feet, the sides of the bank sloping at an angle of 60 degrees. The digging unit consists of a special type worm, having double flights rotating against the direction of travel of the machine. Thus the original structure of the peat is destroyed, the lower layers being mixed with the upper, and the whole mass is delivered into a macerator at a uniform consistency. The macerator consists of rotating knives which further break up the fibers and cell structure of the peat and then the pulpy mass is discharged to the ground just in front of the spreader.

The spreader moves the mass over from the excavation and spreads it in an even layer about four inches thick, the sheet being upward of sixteen feet wide. The sheet is cut into strips as the machine moves along by the cutters as shown in the photograph and it is afterward cross cut by a device not shown.

In each cubic foot of peat as it lies in the bog there is from 10 to 15 pounds of dry fuel, so a large bulk of material must be excavated to produce a ton of fuel—roughly, 7 cubic yards are required. The for-

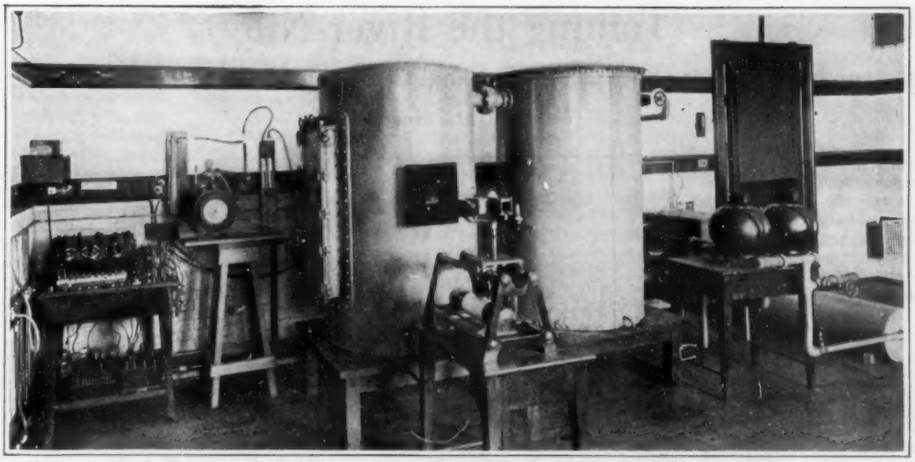
(*Continued on page 532*)

Piling Irish peat for drying. Practically the entire center of Ireland is a vast peat bog, furnishing an almost inexhaustible supply of the fuel

The Atmospheric Tank

TANKS equipped by the National Bureau of Standards are capable of duplicating atmospheric conditions, varying from the driest spell in January to the wettest day in July, as a medium of determining the influence of atmospheric pressure and moisture on the candlepower of gas flames, gas mantels, and kerosene lamps. What effect does a rainy day have on the gas flame or kerosene lamp in your home? is an inquiry not outside the province of this government apparatus.

A constant flow of air at any specified pressure is maintained through the tanks, ranging from pressures of two-thirds to one and one-third times atmospheric pressure. The moisture can be controlled so as to duplicate conditions anywhere between parching aridity and a superabundance of rain. The intensity of the light of the gas flame or kerosene lamp is measured through a glass window in the side of one of the tanks.—By *S. R. Winters.*



Tanks in which varying atmospheric conditions are duplicated, for the testing of pressure and moisture effects on the candle-power of gas and kerosene flames

Producer Gas from Harvest Waste

"CONSERVATION in waste places" is truly a shibboleth all-pervading in its grasp. The evidence is cumulative, the latest innovation being the utilization of wheat, oat, and rye straws in producing gas. The distilled product is the result of tests at the experimental farm of the United States Department of Agriculture at Arlington, Va. An automobile has been propelled with the new combustible and it has been employed for illuminating purposes as well as for cooking. The commercial possibilities of straw gas, however, have not been determined.

The government experiments will relate to the quantity and quality of gas as distilled from wheat, oat, barley, rye, and rice straws, and from cornstalks, corncobs, and other vegetable material hitherto classified as waste. If the scientific investigations at the government farm develop the anticipated commercial possibilities of straw gas, equipment will be devised to facilitate its production by individual farmers. The gas could be utilized in supplying light and heat for the farm home, power for stationary engines, and, possibly, fuel in operating the tractor. Its economic value would thereby be established, conserving raw material frequently burned or permitted to rot in the fields. The supply in the West and Northwest would be practically limitless.

Fifty pounds of straw will yield about 300 cubic feet of gas. Converted into power for propelling an automobile, a light roadster can go 15 miles on 50 pounds of straw. At present, the immediate problem is in the conversion of straw gas into liquid form or condensing it as a possible motor fuel. Among the by-products obtained in the manufacture of gas is carbon residue suitable for making lamp black of fine quality. Likewise, this residue contains limited quantities of potash, phosphates, and nitrogenous compounds of fertilizing value. The tar and ammoniacal liquids resulting from the process, aside from their value as disinfectants and preservatives, may be useful in the dye industry.

Straw gas is not brand new, the process being developed by George Harrison, a Canadian engineer at Moosejaw. The University of Saskatchewan, Canada, installed a straw gas equipment, which was later purchased by the United States Department of Agriculture. The Canadian scientists succeeded in operating an automobile with the product, the fuel supply being transported in a large flexible bag on top of the car. The method, in spite of its wide war-time use in Europe, smacks of impracticability. Still, it may be possible to put straw to some practical use sooner or later.—By *S. R. Winters.*

Charging a retort with straw for the manufacture of gas

The Centrifugal Oyster

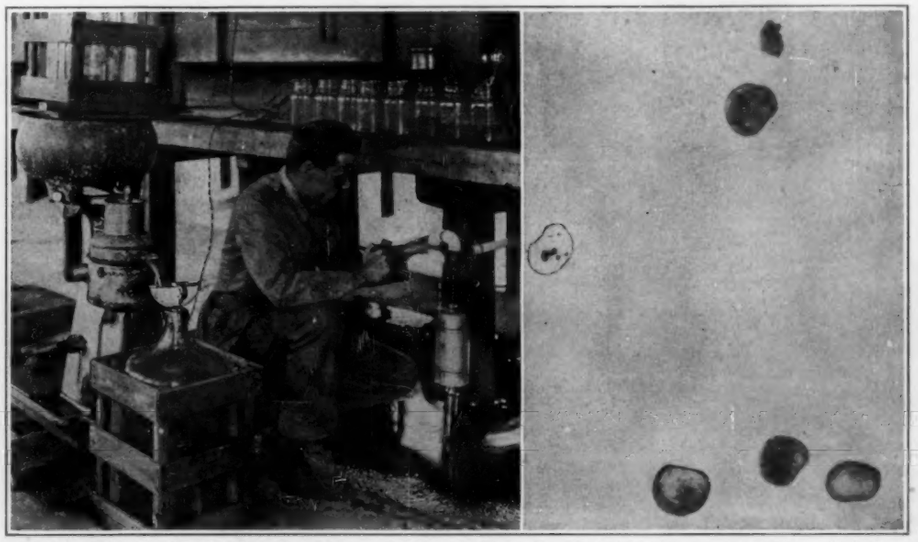
SALVATION of New York's declining oyster industry is promised as a result of the first successful experiments in the artificial propagation of oysters, which have just been completed by W. F. Wells, biologist and sanitarian of the New York State Conservation Commission. The work is part of the broad program for the fullest possible use of the State's natural waters, which is being pushed by the Conservation Commission with every promise of worth while results.

It is a well-known fact that the yield of commercial oysters in the northern and eastern waters has been gradually shrinking within recent years, the main cause of the decline being the continuous and unexplained failure of the oystermen to secure a "set" of young oysters. By "set" the oystermen refer to the habit of young oysters shortly after they have been hatched of sinking to the bottom and attaching themselves to shells and other smooth objects. Once "set" the oysterman can shift his oysters to suitable "growing" and "fattening" grounds, but if the young oysters do not attach themselves to the shells which the oysterman deposits for that purpose, his business naturally fails.

The important facts of Mr. Wells' experiments, which he has been carrying on in an improvised laboratory at West Sayville, L. I., are that he has succeeded in obtaining eggs from oysters and fertilizing them in much the same way as is done with fish in hatcheries, and has then been able artificially to feed and raise the young oysters until they have "set"—a thing which has never been accomplished before. The far-reaching significance of this achievement can readily be seen in the possibility of establishing vast oyster beds in suitable waters from "sets" of young oysters that have been artificially secured. As a single oyster will discharge from 10,000,000 to 100,000,000 eggs each season, the day may be not far off when oysters may come to be a common food of the people instead of being gradually forced into the class of a luxury for the epicure through a falling supply.

The success of Mr. Wells' experiment, where others have failed, has been in the ingenuity with which he has provided fresh food and water for his microscopic charges. Previous investigators have frankly admitted that they could devise no means of changing the water without losing the minute forms, which have consequently started before reaching the "setting" stage. Mr. Wells has overcome this difficulty by using a centrifugal machine, and in this way concentrating millions of little oysters from a large volume of water into a small bowl. They could then be transferred to fresh water containing food and other living necessities. At first it might appear that such delicate animals would be injured by passing through a centrifugal machine, but, being enclosed in shells, which act as a protection, Mr. Wells found that they could be concentrated in the machine without any injury.

About one month after hatching, the little oysters, which are free swimmers during that period, adhere to shells and even "set" in large numbers on the glass sides of the receptacles.



Left: **Centrifugal machine in which microscopic eggs are separated from the water when it is necessary to change the latter, and glass jars for transferring the resultant "concentrate."** *Right:* **14-day-old oysters magnified 100 diameters**

Some details of the artificial propagation of oysters

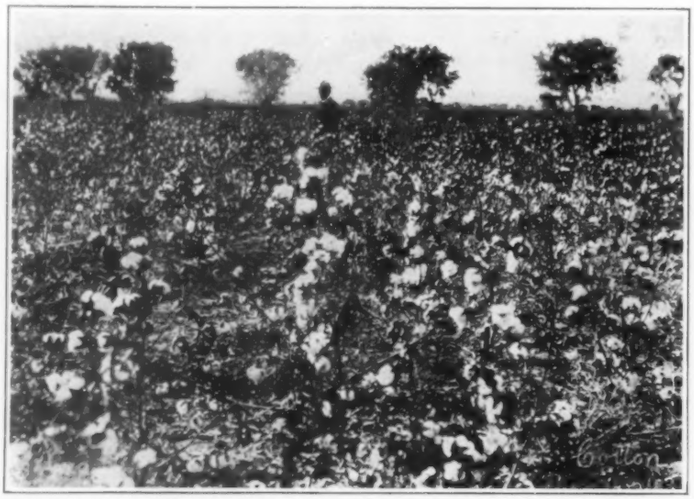
Taming the River Nile

Construction of Dams and a 225-Mile Canal to Double the Irrigated Area in Egypt

By H. C. Hardy

IT will come as a shock to many proud Americans to know that neither the enormous irrigation project of our far-famous Reclamation Service nor the Panama Canal is destined to remain the largest man-made water works in the world. Egypt, ancient home of the art of irrigation, is to come into its own with an irrigation system which will make ours small by comparison and dwarf the great Aswan (used to be Assuan) storage dam as the Panama Canal dwarfed the Erie.

The matter is of especial interest to us, however, from the fact that in the settlement of the principles which had to be enunciated before this great enterprise could be carried out, an American engineer had a leading part, and because of this settlement a principle of equity in water was enunciated which may have a very large part to play in the relations of the United States with its neighbors, Mexico and Canada.



An Egyptian cotton field, the main reason for the great irrigation project

Most readers are familiar with the part the Nile plays in Egypt; so intimately interwoven with the land of the Pharaohs and the cradle of civilization is its great river that literature and history are filled with it. Thoroughly to understand the present great project, however, it is necessary clearly to visualize not only the Nile as a river, but as a source of irrigation.

The huge river has an average difference between mean and flood water of twenty-five feet. During flood water, since the memory of man runneth not to the contrary, it has been the custom of the Egyptians to cut canals through the banks of the river, draw the water off into the valley of the Nile where it is confined in basins, there to settle and deposit its rich alluvial silt, and later to be allowed to flow back again into the river, less that lost by evaporation and sunk deep into the soil. In a rainless country, the water thus remaining in the unusually rich soil deposited, grows crops with speed and profusion.

The more Nile water which can be used, the greater the area which can be flooded, the more crops which can be grown, the greater the income to both the people and the State (since there is but one tax in Egypt and that upon the land irrigated). No water, no irrigation; no irrigation, no tax. A low-flood Nile has meant famine and starvation and a depleted treasury; a high-flood Nile has meant plenty and great crops and a full treasury as far back through the past as the records of our oldest civilization go.

But, as was natural to an agricultural people who knew nothing of irrigation as a science, the native Egyptian methods are wasteful and inefficient. Moreover, the most profitable of all crops, cotton, must be planted early in the year, at the time of low water, and for cotton continual irrigation is necessary, not merely one period, such as suffices for the maize and grain crops.

To produce water for cotton raising during the period of Nile low water, a great barrage (we should call it a division weir) was constructed twenty miles below Cairo by French engineers. It was supposed to raise the level of the Nile at least fourteen feet, but because of the lack of a firm foundation on which to build and the lack of knowledge of irrigation work at that period, the structure bulged in the middle, cracked, and could safely be used only for a raise of three feet of water. This was in 1880. In 1882 the Allied powers took charge of the chaotic finances of Egypt and English engineers put down a flat weir below the French works, relieving the strain and making the French weir to some extent useful.

The year 1885 saw the long staple cotton crop, which grows only in Egypt and in one small velley in this country, well begun. This long cotton is three times the value of ordinary cotton and of huge profit to the land of Egypt as well as the State. Naturally Egypt wanted to use more and more water at times of low water to grow the crop which brought wealth to both country and grower.

The eminent English engineer, Sir William Willcocks, suggested the great storage dam at Aswan, at the lowest cataract of the Nile, which was begun in 1903. But it was not built as high as he wanted it built because of entirely sentimental reasons—the little island of Philae has upon it a wonderful old ruined temple, which was held by many to be of more importance than irrigation or cotton. To build the dam too high would be to cover the island and the temple. Let no one laugh who reads—the reformer we have always with us and Niagara is, and probably always will be, a bone of contention between the beauty lover on the one hand and the electric industries engineer upon the other.

However, time brings changes and time brought an ever increasing demand for water. Great as was the Aswan dam, it was not great enough, even after it was raised in 1912, to a sufficient height to cover Philae at high water and immerse the temple beloved of historians and archaeologists. Egypt planted more and more cotton and demanded more and more water from low-flood Nile in the spring. There were two and a half billion cubic meters of water backed up behind Aswan dam—two million acre-feet of water, all useful save the twenty per cent lost in evaporation. But it was not enough, especially was it not enough when the war began to demand cotton, cotton and still more cotton, for its textiles and its explosives.

Sir William Willcocks suggested a still higher dam, below Aswan. Sir Murdoch MacDonald devised a plan to build dams above Khartoum on both the Blue Nile and the White Nile, thus going into the Soudan for water, a plan which also included the irrigation from the Blue Nile of three million acres in the Soudan.

To use the White Nile as a source for

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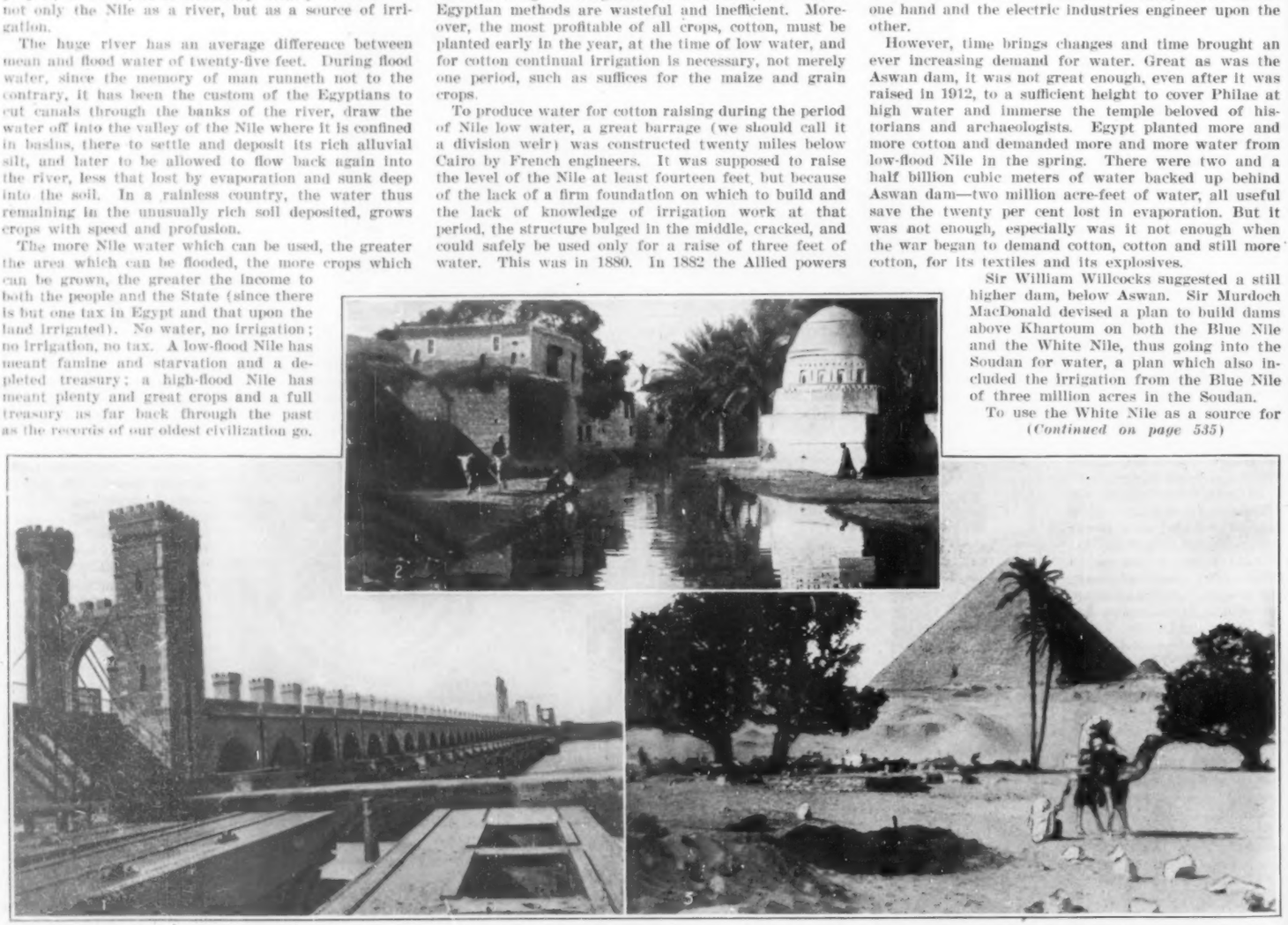

1. The existing delta barrage across the Nile. 2. A native village, with sheikh's tomb, in the area to be affected by the latest dam. 3. The great pyramid of Cheops, affording an ancient setting for the works of modern engineers

Where the world's greatest man-made water works are to be created, in the fruitful Nile valley

Keeping Tabs on Bird Peculiarities

By George H. Dacy

"AND the birds of the air, they labor not, neither do they spin, yet they know when the summer is nigh," is a Biblical excerpt which appropriately presents our lack of knowledge concerning the everyday doings of the myriads of native birds and which accurately describes their remarkable migratory instincts. Heretofore, sporadic and unsystematic efforts have been attempted on the part of unorganized and individual bird lovers and fanciers to ascertain some definite facts and figures on the goings, comings and everyday activities of the birds of their localities. These investigations were, to a certain extent, centralized eleven years ago when the American Bird Banding Association was organized. The recent absorption of this work by the United States Bureau of Biological Survey promises a marked and potential expansion of the investigational activities.

By the systematic trapping and banding of birds for identification purposes, it is possible accurately to keep tabs on the potential operations of a limited number of these birds which react favorably to trapping and which soon acquire the habit of returning, season after season, to the same feeding stations where they were originally caught. A bird soon learns that it is always assured of a square meal every time it visits the feeding station and that it will be given its freedom again after being fed and examined. Some birds such as the cardinals actually become obnoxious around the traps, remaining in the neighborhood continuously, entering the traps and preventing the entrance of other birds. In a word, the free meal idea appeals to the cardinal and, whenever possible, this tramp of the bird family avails himself of lunches of this description.

The English sparrow trap—originated by the national Department of Agriculture for the capture of such marauders wherever they became objectionable and injurious to crop culture—is used chiefly in snaring the wild birds. The trap is ordinarily baited with finely cracked grain such as commonly is sold as baby chick food. The grain is scattered thinly as far as five feet from the trap while crusts of bread are spread inside the wire cage. In the majority of cases the trap is placed on the ground and surrounded by a guard fence of chicken wire about 60 feet in circumference to protect it from the neighborhood cats and pet dogs. Only where it is desired to capture the birds which live in the tree tops is the trap ever placed in a tree.

The preferable time of the year to catch the birds is during their migrations or after they have established their residences for the season, although in most instances the birds respond to the bait at most any period after they have once been trapped. When a bird is captured for the first time, the bird lover should place a small identification band around the leg of the bird. The bands in use at present bear the inscription "Serial Number——, Notify Biological Survey" on one side and "Washington, D. C." on the other. In applying the band it is necessary to hold the bird firmly but gently so that it cannot flutter.

In cautioning the novitiates in bird study about handling the little fliers, a bird expert makes the following suggestions: "For examination, the bird is best held sitting upright, resting with his claws on the little finger, and with his neck between the first and second fingers. In this position the bird will rest placidly, even with the hand left open, so the entire body of the bird may be examined easily. In placing a band, the bird is preferably held on his back, with the little finger snugly over the throat, so that the thumb and first finger are in position to hold the leg while the band is adjusted. A record is kept of the family and species of each bird that is banded so that subsequently this information and his serial number may serve to identify him each subsequent occasion when he visits the feeding station."

The American Bird Banding Association aggregated 350 members, some of whom were expert ornithologists, although the majority were bird lovers and opera glass students without scientific training. During its existence its members banded between 18,000 and 19,000 birds and of this number approximately 375 were subsequently recovered. The mortality in bird life is very heavy and this is largely explanatory of why the recoveries on the part of the average bird student are only two or three per cent of the total number of birds which he catches and bands. Previously, systematic trapping has not been practised as efficiently as it could have been. The experts of U. S. Biological Survey hope to extend the potential recovery record to about ten per cent of the birds which are banded.

In extending its investigations the Biological Survey is extremely anxious to get in touch with all bird lovers in the United States, especially with those who would be interested in coöperating with Uncle Sam in his bird study experiments. All those who now feed birds regularly can assist greatly in this campaign for increased knowledge about the birds by corresponding with Biological Survey, Washington, D. C., in order to be enrolled on the official list of feeding stations and to be provided with government bands and records for keeping track of the birds. At this time, lack of funds prohibits Uncle Sam from furnishing his layman field forces with traps. However he will supply simple plans and specifications so that any tinsmith can construct one of these traps without difficulty. If the bird lover prefers to purchase the trap on the market, it can be secured at a moderate price from Mr. J. Warren Jacobs of Waynesboro, Pennsylvania.

There are three distinct highways of land bird migration in this country where volunteer students can perform effective work. The first line of flight is along the Mississippi River Valley while the other two, respectively, are along the Atlantic and Pacific coasts. It is particularly noteworthy that during the migrations the birds do not make regular flights every day. They stop for some days in sections where the food is abundant and usually will resume their journeys

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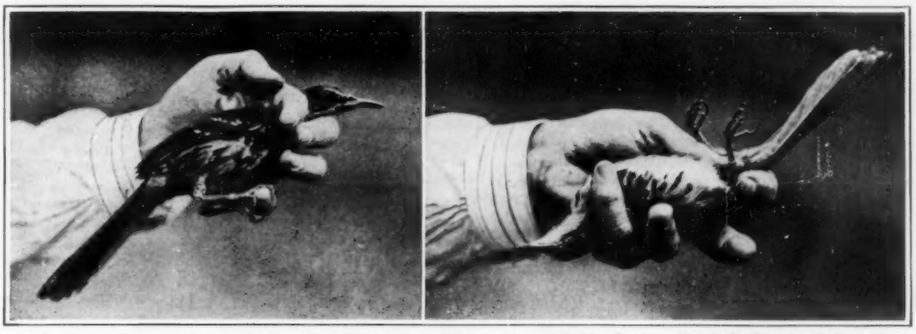
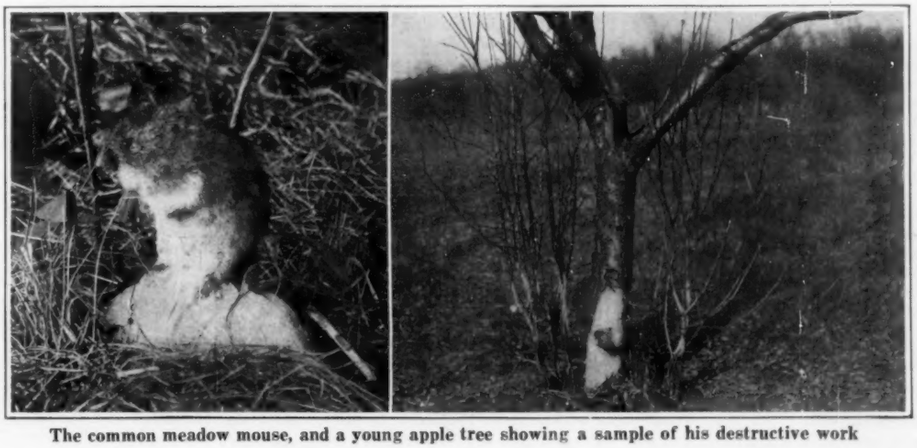


Left: For examination, the bird is usually held sitting upright, resting with his claws on the little finger and his neck between the first and second fingers. *Right:* In placing a band, the bird is held on his back, with the little finger snugly over the throat so that the thumb and index finger can hold the leg as the band is adjusted

How migratory birds are examined and how they are labelled by means of leg bands



The common meadow mouse, and a young apple tree showing a sample of his destructive work

How Meadow Mice Destroy Trees

By William A. Murrill, Ph. D.

ONE day early in March, I saw about noon at the elevated approach a brown rat, a gray squirrel, and a cottontail rabbit. The first two were actively hunting for something to eat, while the rabbit sat on the snow with its eyes to the sun fast asleep.

The brown rat is always with us, and is not only very destructive but helps to spread many diseases. The gray squirrel continues to be the delight of park visitors in spite of its shiftless habits, its fondness for buds and maple sap, and the fact that it destroys birds' eggs and young birds before they are able to fly. Two specimens of the black variety are frequently seen in the hemlock grove. The cottontail rabbits are fairly abundant in our grounds, making their nests near the buildings and being quite socially inclined. Although destructive in many sections, the injury done by them here is so slight as to be negligible. They seem to stand on top of the snow and reach for the young twigs, which they nip off with a clean cut. I do not know of a single case of girdling which can be attributed to them.

But the common meadow mouse is very destructive every winter, and he was unusually so during the one of 1919-20, doubtless owing to the abundance of snow and ice.

Walk through any grassy meadow and you will notice little runways forming a network over the surface of the soil and winding in and out among the vegetation. These are made by mice about as long as the common house mouse but with thicker body and shorter legs and tail. They keep the runways very smooth and free from straws so as to reach their burrows quickly in case of alarm.

In their comfortable nests of dry grass, several litters of from four to eleven young are reared each year. Hawks, owls, crows, foxes, weasels, and other natural enemies prey upon them continually—and still they increase. They consume large quantities of growing and matured crops and often destroy entire orchards by gnawing the bark from the base of the trunks and roots of trees. In winter they tunnel under the snow from one tree or shrub to another.

No store of food is laid up for cold weather by the southern species, but there is one in Alaska that gathers and hides in its nests a quart or more of little bulbous grass roots, which the Eskimo women search for eagerly and boil to serve to their guests during winter festivals.

To recount all the damage done by meadow mice in their search for food on our grounds during the past winter would make quite a story. A great many different kinds of trees and shrubs were attacked; and the attack was made in different ways according to the quality of the bark, the depth of the snow, the amount of dry grass present, etc.

The object of the mice being to get at the food stored in the inner bark, it was necessary for them first to gnaw away the outer corky layers, after which the tender inner layers were consumed down to the wood. On account of this complete girdling no food can pass to the roots, which will be speedily starved out and the trees will die. In the case of shrubs new shoots will spring up, but this will take some time.

Several of the splendid Japanese flowering cherries were completely girdled for a distance of six inches or a foot near the base. Four of these are young trees, six inches in diameter, and good bloomers; while one belongs to the first lot set out many years ago. Two other fine trees in the cherry orchard are nearly girdled and will either die or become practically worthless.

(*Continued on page 536*)

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Research in Laundering

INTEREST is being aroused in Great Britain to undertake industrial scientific research in the laundry industry, and as an example of what may be accomplished reference is made to the research work conducted at the Mellon Institute, upon a Fellowship founded by the Laundry Owners National Association. Some of the problems awaiting solution are the economical use of heat and steam power, improvements in the construction and design of washing machines to reduce the mechanical wear on goods to a minimum, and a fundamental study upon the mechanical side of laundry practice involving such factors as time, temperature, and concentration. Then there is the influence of the ironing temperature upon the wear and tear of goods, and research upon the relation of design and weave of fabrics to laundry wear in order that we may choose the fabrics best suited to withstand this wear for those articles, such as collars, which require frequent laundering. The properties and most efficient uses of starch and the removal of old starch are other important fields. The removal of stains and scorch are further problems.

The results of research of this character would not only be of economical value, but would assist us in placing responsibility where it belongs, whether manufacturer, purchaser, or laundry man.

Clay Soap

IN the January issue of *Chemical Age* (London) Mr. F. E. Weston discusses the utilization of colloidal clay in soaps. According to this writer the concentration of soap on the surface of the adsorbing bodies is the first factor in the detergent action of soap. Soap in water lowers the surface tension of water against air, and clay can be rendered so highly colloidal that it will display the same physical behavior in lowering the surface tension of a liquid in which it is in solution. Therefore, when such clay is properly mixed with soap it increases the detergent properties of it. In fact, it is reported that clay lowers the surface tension of water to an even greater extent than does soap itself, and experiments conducted with high grade soap with and without colloidal clay have verified this assertion. The commercial importance of this work will be in the replacement of a part, at least, of the fatty acids now used in soaps.

Standardization of Glue

THE present standards by which glues are marketed are arbitrary and unfortunately not based upon scientific data. In the *Journal of Industrial and Engineering Chemistry* for April, George Hopp presents a new method for determining the tensile strength of glue which appears to give the exact strength and stretch of the material, its elastic limit, and other physical properties. Such a test will permit manufacturers to vary their processes and raw materials, determine the effect on the finished product, and permit the establishment of a standard which can be expressed in absolute units determined by scientific methods.

The method consists in melting the glue, pouring it into molds, and obtaining the stretch and strength of the sample on a tensile-strength machine, using cut strips of definite size. The article gives results of the work and outlines at least eight problems now under study to determine the effect of the variation of different factors upon glue.

The Metallurgy of Tungsten

DR. C. W. BALKE has recently addressed scientific meetings on the metallurgy of tungsten, accompanying his presentation with various samples of this important element which but a short time ago presented what was then one of the most difficult technical problems. It will be recalled that this problem was that of producing ductile tungsten for use in incandescent lamp filaments and that success in this project is largely responsible for the efficiency of modern illumination. Today an equally important use of the element is in the manufacture of high-speed tool steel, in which utilization more impure material can be used than for filaments. The production of powdered metal from the ore is comparatively simple. This material is then pressed into ingots in hydraulic presses developing 250 tons per square inch. These ingots are then heated in an atmosphere of hydrogen to about 3,300 degrees Centigrade, which is just below the melting point, 3,350 degrees, tungsten having the highest melting point of any known metal. This sintering operation is controlled to produce a desired grain size in the mass. The mechanical work in producing pure tungsten wire is complex, and involves heating the ingots in special furnaces in an atmosphere of hydrogen and swaging the heated bars down to required size. The metal is passed through the swaging machine a great many times, as no more than 10/1000 of an inch reduction is accomplished each time. Eventually a size of 30/1000 of an inch is reached, after which the wire is drawn through steel dies until it is 20/1000 of an inch in diameter. Diamond dies heated to redness are now used until 15/1000 of an inch is obtained.

The manufacture of tungsten and its products requires very careful technique using hydrogen under dangerous conditions. It affords an excellent example of the development possible through chemical engineering, involving mechanical and electrical problems as well.

Isolation of Vitamines

IT seems certain that the study of vitamines will influence our work upon foods to as great an extent in the next twenty years as has sterilization during the past generation. Isolation of vitamines is a particularly important study for there are a number of cases where cheaper foods could be made entirely satisfactory if we knew of some way to add, concentrated, the particular vitamine which it lacks.

In the proceedings of the National Academy of Sciences experiments upon the chemical isolation of vitamines are reported by Myers and Voegtlin. Working upon brewers's yeast, which is very rich in antineuretic vitamine, it was found that olive oil and oleic acid will remove the vitamine from the autolyzed yeast filtrate. The active material is readily extracted from dried yeast with acid methyl alcohol. The physiological action of the active fractions resembles that of extracts from the mucosa of the small intestine when the two extracts are purified in like manner.

American Potash

FOR several years experiments have been conducted working toward the production of potash from the green sands of New Jersey. These sands are to be found in large quantities and contain about 7 or 8 per cent of potash. The Eastern Potash Corporation of New York is now constructing a plant designed to produce a thousand tons of potassium oxide annually. With this there will be residue estimated at 600,000 tons, which will be employed in manufacturing a silica lime type of brick. For this purpose the largest lime plant in the world is to be erected in conjunction with the potash plant. The equipment of the lime plant will consist of ten 8 x 125 feet rotary kilns producing a thousand tons of lime a day. The brick plant will have a capacity of 500,000 brick per day and this can be doubled if the demand justifies it. The project of winning potash from the green sands of New Jersey has been under consideration long enough to indicate that a sound foundation has been developed for this enterprise and the outcome will be watched with interest.

Glycerine from Sugar

IN a recent issue of *Chemical Age* are to be found quotations from certain German technical papers to indicate that glycerine was produced upon a large scale from sugar in Germany beginning in 1915. Early in the war Germany had a considerable excess of sugar and the population was urged to use plenty of sugar on account of its food value. Later, however, on account of various uses found for sugar it became scarce and people found it difficult to follow the advice given earlier. The transformation of sugar into glycerine was accomplished by a biochemical method. It was known that with yeast, fermentation of sugar could be carried on in a way to convert 3 per cent of the sugar to glycerine; by the addition of various alkalies this percentage could be increased, and sodium sulfite was found to be the best material. As much as 36 per cent of the sugar was converted into glycerine. Acetaldehyde was also produced and was used for war purposes. The production of glycerine by this method exceeded 2,200,000 pounds a month and is a striking sample of the possibilities in the new fields opened through biochemical processes.

Textile Misbranding

THE Federal Trade Commission recently ruled that seventeen concerns engaged in the manufacture and sale of underwear, shirts, and other wearing apparel must refrain from certain unfair methods of competition in commerce. The Commission's ruling made by agreement with the trade calls for more accurate branding of woolen goods and the firms named agree to refrain from using such brands as wool process, Scotch wool, Saxony wool, merino, or other descriptive brand to describe material not composed wholly of wool, unless the term describing the stock is coupled with the name of the other staples present in the fabric as, for example, worsted and cotton, or wool and cotton.

This is among the few rulings which have been made in the interest of textile branding. There are ordinances in several cities which if enforced would operate against the use of misinformation in advertisements, but these ordinances are seldom enforced. There is, however, one instance where the chemical laboratory was called upon to ascertain whether goods advertised by a merchant temporarily sojourning in a city conformed to the placards. The result was that the merchant moved on to other fields. The administration of laws designed to uphold recognized textile standards is difficult, but the time is certainly approaching when some way will be found.

Concrete Tanks for Water Storage

TESTS on concrete tanks for water storage have been under way at the Bureau of Standards, where concrete of a mixture 1:2:4 were employed. After 150 days the day loss curves became a straight line indicating that the daily loss had become constant, and while the tanks showed some actual loss due to the penetration of the concrete by water they remained perfectly dry on the exterior. The head of water was 35 feet, but from the facts cited it would seem that this mixture when properly placed is waterproof to a satisfactory degree.

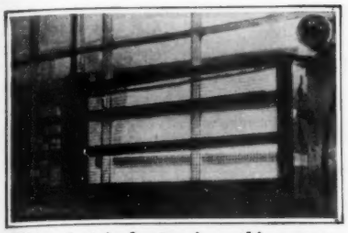
Colloidal Fuel

NOTATION has previously been made in these columns of work done upon colloidal fuels by a number of chemists and chemical engineers. Since the processes devised under pressure of war emergency are applicable to various types of wastes, it would seem that colloidal fuels are sure to play an important rôle in the near future. If, as is claimed, such coal waste as culm, screenings, and dust can be used as well as peat, lignite, and sawdust, such a compounded fuel is indeed of unusual importance. Colloidal fuels are a combination of such fuels, particles of which are reduced to a size to make them colloidal, held in emulsion form by soap-like substances. When dispersed in fuel oil, tars, etc., can be held in suspense with sufficient permanence to permit storing, piping, and burning the mixture with the same facility as fuel oil itself. The subject is discussed by Jerome Alexander in the *Journal of Industrial Engineering Chemistry.*

Water in Milk

A METHOD for detecting added water in milk has been devised by Dr. Hortvet of the Minnesota State Dairy and Food Commission. It is based on the constancy of the freezing point depression of milk observed by Beckmann in 1894. Milk has a constant freezing point due to a definite and constant relationship between the osmotic pressure of the blood and that of the secreted milk. Now, normal blood is constant in its osmotic pressure and milk must, therefore, also be constant. The freezing point of normal milk is its most constant factor, and while the osmotic pressure of milk would vary from the normal in under-nourished or diseased cows the marketed fluid is a mixture which is quite constant in this respect. It is not affected by the variable fat content nor the protein content and is the same for the first as for the last milk drawn, as well as for skimmed milk, separated cream, and the whole milk. The cryoscopic method distinguished between a normal milk of high water content and an artificially watered product.

The constancy of the freezing point has been established by many thousands of tests and the limits of depression have been found to be 0.54 degrees C. to 0.56 degrees C. The method has been found satisfactory to a minimum of 3 per cent of added water.



This electric heater is nothing more than an old bed spring mounted on a wall

From Bed Spring to Electric Heater

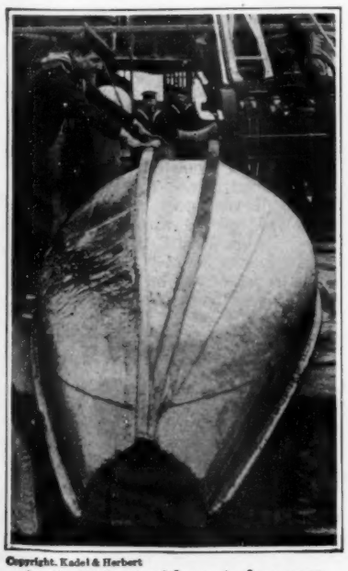
IN its crudest form an electric heater is little more than a mass of iron wire which heats up as electric current is passed through it. This thought must have made a deep impression on a certain youth of Glenn Falls, N. Y., who rigged up an old bed spring in the manner shown in the accompanying illustration, for the purpose of heating his room.

Current from a pair of 110-volt wires is passed through the entire bed spring, causing the iron wires to heat up. Obviously, such an improvised heater is by no means the last word in electrical efficiency, but as an ingenious makeshift it is really commendable. No data is available as to the current consumption of this unique electric heater, but it must run up into several kilowatts if an entire bed spring is utilized and the heat obtained is considerable. And as to whether it is efficient or not, depends largely upon who pays the electric bill!

Putting Runners on the Arctic Lifeboat

WHEN the British ice-breaker "Sviatogor" left Rosyth, Scotland, bound for some point in the Kara Sea where a number of Russian men, women and children were ice-bound on board the steamer "Solovie," she had many of the earmarks of the usual polar expedition equipment. Among other things were the lifeboats equipped with double runners, one of which is shown in the accompanying illustration. These lifeboats serve in a dual capacity, namely, as lifeboats in the water and as roomy, if somewhat awkward, sleds over the ice-covered waters.

The "Sviatogor" is one of the two most powerful ice-breakers in the world. She was sent to the rescue of the "Solovie" in response to the wireless calls of distress.



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Arctic lifeboat with a set of runners for traveling over ice fields

Music Lessons for the Canary

AN enterprising young woman has recently established a conservatory of music where canaries are taught how to sing sweetly. A corner of this odd establishment is presented in the accompanying view, showing the feathered pupils, the director, and an ingenious compressed air apparatus which produces the desired music for the birds.

Briefly, the singing course is simply a matter of blowing different whistles which the birds mimic more or less faithfully according to their training. These whistles are mounted at the top of the cylinder in the center of our picture, in a metal box which is provided with a hinged door. The top cylinder telescopes with the bottom cylinder, so as to form a pump. The top cylinder is raised by means of a counter-weighted cable and allowed slowly to settle down into the larger or lower cylinder . The air compressed in the cylinders is permitted to escape through one or more whistles, thus producing the desired sounds for training the birds in the nearby cages.

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Teaching canaries how to sing with a compressed air battery of whistles

Paper, Paste and Ingenuity

WHILE we have been reading and hearing of the marvelous paper goods produced by Germans and Austrians ever since they became isolated during the World War, our own paper industry has been forging ahead along highly interesting lines.

Never before has there been such extensive use made of paper in one form or another. Certain manufacturers are turning out all kinds of paper goods from which numerous novelties can be produced. For decorative purposes certain manufacturers are producing so-called fire-proof crepe paper, which is a paper treated so as to burn quite slowly, removing the usual hazard connected with the use of paper. Papers finished to represent various kinds of wood are now used in making small frames.

The accompanying illustration represents a typical application of paper products. Here shown is a lady's hat made entirely of crepe paper, cardboard for the shape, and a few flowers or fruit of paper for the trimmings. True, such a hat is a short-lived novelty and will not stand rain; but is it any different with the usual lady's hat?

New Coal Fields in Spitzbergen

THE director of the Swedish coal fields in Spitzbergen, Mr. Granholm, who has just returned to Stockholm, confirms the statement recently published in a local paper regarding newly discovered coal deposits on that island. It appears that these have been found at a depth of 26 feet below what has heretofore been considered as the bottom of the "Svea Mine." The vein recently opened, according to the director, has an average thickness of over 6 feet, with an estimated area of about 16,000,000 square feet. Up to the present none but expert miners have been employed at the "Svea Mine" in Spitzbergen, because of the difficulty in working the old 80-centimeter vein, but in the new vein unskilled labor may be utilized.

During the present year the output is expected to be 36,000 tons against 18,000 tons in 1919, while in 1921 the director estimates that at least 72,000 tons will be ready for shipment.

A Fountain in a Bottle

A VERY curious little experiment may be carried out with a few simple materials. First of all fill a four-ounce bottle three-quarters full of water. Pierce the cork and insert a glass tube of small diameter. This tube must be long enough nearly to reach to the bottom of the bottle and project a little above the cork. Seal the cork airtight with sealing wax.

Now fold several sheets of wet blotting paper and stand the bottle on this. Next, get a large glass jar and hold this upside down over a lamp or a candle flame so that the air is well warmed. Then, still in an inverted position, press the jar over the bottle taking care that the edges are in close contact with the blotting paper so that the outer air is excluded.

In a few minutes the contraction of the air in the jar as it cools will cause a jet of water to rise up from the bottle. This will reach almost to the top of the jar and will be like a miniature fountain. If the glass tube is slender, so that only a little water passes at a time, the fountain will last quite a long while.

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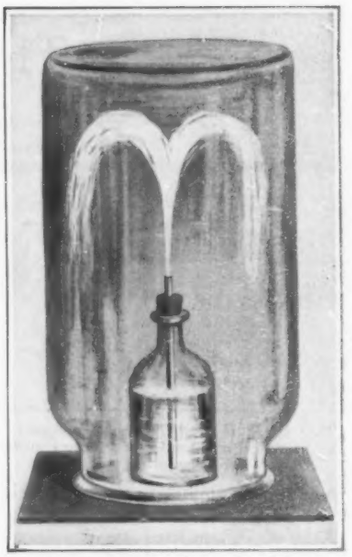
This paper hat costs 25 cents and lasts long enough to serve its purpose

The Vertical Camera and Its Uses

FOR the photographing of machinery parts, jewelry, books and other loose objects, the vertical camera is employed in most of the leading commercial studios. Such a camera forms the cover subject of this issue.

The vertical camera can be racked up or down so as to secure an image of any desired size; and the focusing is accomplished by racking the rear end of the camera up or down until a sharp image appears on the ground glass. Where small objects are to be photographed and absolute sharpness is necessary, it is not unusual for the photographer to make use of a ground glass sheet under the subjects. A light coming up through the ground glass on which the subjects rest facilitates the work of focusing the camera.



A fountain produced in a bottle by simple means

Thawing Frozen Water Pipes by Electricity

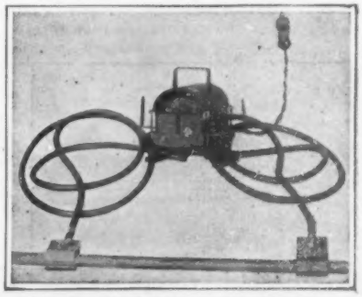
ONE of the latest developments in electrical convenience is the electric pipe thawer. Its function is to thaw frozen water pipes in a house electrically, a method which has considerable advantages over using a gasoline blow torch, or other ways attended by more or less fire hazard and inconvenience.

The device consists of a small transformer which can be connected to the house lighting circuit by means of a 10-foot lead and separable attachment plug which are provided. The two secondary cables, or those which are attached to the pipe to be thawed, are each seven and a half feet long and end in a cast brass clamp which can be used on pipes varying in diameter from one-half to one inch.

The purpose of the transformer is to reduce the lighting voltage to a point where a sufficient heat will be produced to thaw the pipes. This heat is produced by the resistance of the pipe itself to the flow of the current, and only about the same amount of energy is used as in running an electric flat iron.

In thawing out a pipe the nearest faucet should be turned on, and the secondary leads of the transformer connected to the pipe at a point nearest the entrance of the pipes from the street, the pipe being heated in sections until the water flows out of the faucet. The time required to thaw out a pipe depends on how long the frozen section is, the size of the pipe, and the degree to which it is frozen.

The whole apparatus is very compactly made, and easily portable, having a handle welded to the transformer case and weighing only 35 pounds complete.

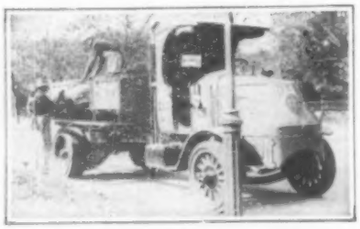


This electric thawing device thaws out frozen pipes in sections

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



This truck is a sprinkler in summer, an enclosed ash and garbage collector in winter

Double Service Municipal Truck

THE advantages of motor trucks for municipal use have been previously considered in these columns and many interesting examples of trucks have been illustrated. One of the drawbacks to the use of specialized equipment has been that in some cases it could not be profitably employed all of the year round. The accompanying illustration shows a double-service truck equipped with special bodies that are easily removed so that the same chassis can be employed for a number of distinct body types. For example, for summer service these chassis are fitted with large capacity tanks equipped with flusher and sprinkler attachments. During the winter season, when watering the streets would make traffic hazardous, even though it was thought necessary, the same chassis are converted into automatic dump trucks with enclosed steel sanitary garbage and ash-collection bodies.

At a time when increased facilities are needed for removing ashes, due to the universal use of heating equipment that is idle during the summer, the added motor equipment necessary is obtained by mounting relatively inexpensive bodies on the more costly chassis, which would otherwise remain idle if the design did not include the convertible feature. It was formerly necessary to lay up flushers and sprinklers during the winter months, this representing a considerable loss on the truck investment. The advantages of trucks adapted for the quick interchange of body equipment are apparent and attachment of special municipal adjuncts make an all-the-year truck investment. The machine illustrated is one of a large fleet of similar designs, used by the New York Street Cleaning Department.

Trailers Reduce Cost

SLOWING down of business conditions and curtailment of credit in many lines have not affected the trailer industry much, according to reports of members of the Trailer Manufacturers' Association. There have been few cancellations and these have been offset by increased orders. The trailer people expect that as general business gets down to a more economical basis, manufacturers and merchants will look more closely to the cost of transportation and will adopt the trailer more generally as a sure means of reducing the cost of haulage and delivery. The increase in railroad freight rates is confidently expected to result in a larger development of the ship-by-truck movement. Shippers have already found that goods can be shipped more cheaply and quickly by motor truck than by rail for distances of fifty miles or more, and with an increase of 20 per cent in rail rates, there will be a still greater inducement to patronize the highway lines. The reason for the popularity of the tractor and trailer for nearly all hauling purposes can be very well understood by referring to the accompanying illustration which presents in a graphical manner the argument advanced by those favoring the use of trailers.

A maker of automobile parts uses this trailer in his delivery to advantage

Trucks in Imperial Valley

THAT motor trucks are called upon to work under the most adverse conditions, but are meeting those conditions in a manner characteristic of an engineering achievement, is shown by fifteen motor trucks operating in the Imperial Valley, California, which is 119 feet below sea level with roads built of silt deposits from the Colorado River. It is situated about half way between Los Angeles and San Diego, and has a total population of 60,000 people who last year produced $66,000,000 worth of products. The water is all brought in by canals from the Colorado River. On account of the soil being silt, the roads are very bad and extremely dusty. It is the opinion of people living in California that there is no place in the United States where a motor truck is put through such unusual tests as in the valley.

During the summer months the temperature very seldom goes under 100 degrees a day or night and during the daytime the thermometer reaches from 130 to 135 degrees in the sun. For many months this fleet of fifteen motor trucks has been operating continually without interruption in the Imperial Valley hauling cantaloupes, watermelons, etc., from the fields to the packing pits and to the refrigerator cars under the most adverse conditions, not only in temperature, but in contending with traction difficulties due to the soft fields and sandy silt, hub deep, piling up in front of the wheels. An instance that shows climatic extremes with which these machines must contend is that of a 2½-ton power wagon loaded with watermelons weighing 8,500 pounds, starting from the valley 119 feet below sea level, making 70 miles of mountain grades after dark, reaching an altitude of 1,420 feet and then down to sea level again at San Diego.

Truck Saves Money in Road Building

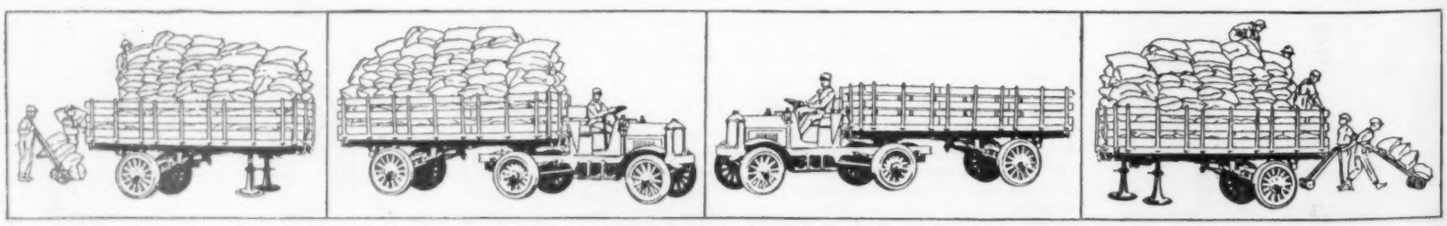
A THREE-AND-ONE-HALF-TON motor truck, equipped with a combination dump body, is doing state road work at Belgium, Wisconsin. It is said that this truck took the place of seven teams and saved the owner $33.25 per day. This road contractor, while doing State work, recently made some very interesting discoveries regarding the motor truck in road building. He was employing seven teams and fourteen men at the time the three-and-one-half-ton truck was received and set to work. The seven teams had each hauled three loads per day of one and one-half yards each, a total of thirty-one and one-half yards per day. By truck two men hauled thirty-three yards of crushed stone each day. Figuring the cost of each team and driver at $7.25 per day, the contractor was paying $50.75 per day for his seven teams. Assuming $17.50 per day for one motor truck, it will be seen that the motor truck saved him $33.25 per day.

It has been proved times without number that the motor truck will do as much work as six to eight horses and is much more economical to maintain and some users claim almost double that figure, the cost per day to operate four teams being in one case $29 and the cost per day to operate one truck $17.50. Here is a distinct saving of a trifle over forty per cent, and that is not all by any means.

Motor truck with interchangeable dump and stake-bodies, used effectively on road work

The all-steel dump body used was equipped with a special hoist. On two-ton bodies, 12-gage steel is used and on three-and-one-half and four-ton bodies 10-gage steel, while on all bodies the front end and tail gate are made of 8-gage steel. To preserve proper balance in dumping, all wide bodies of three and one-half tons have a special design worked out in the hook-up of the hoist to the body, which provides a front bearing for lifting of forty inches between centers. Consequently, an uneven load does not throw the cross strain into the body as does the usual narrow hook-up. For rock, sand and gravel, the four-and-one-half-ton truck has a length of 132 inches and a total width over the flare of 81 inches, the height being 16 inches, with a capacity of three and one-half cubic yards and a weight of nine thousand pounds.

The combination dump and stake body is sometimes used to combine the advantages of the all-steel dump body with those of the stake body, having dump- and stake-body sides interchangeable. The dump-body sides, and the stationary battlements which support the lifting arms, are constructed of rolled steel, reinforced with angles. The battlements, 24 inches high and 30 inches long, unite with the dump-body sides in forming an inside body compartment that can be dumped absolutely clean in twenty seconds. The tail gate for use with the steel body sides has its opening regulated to permit gravel, crushed rock, or other materials to be spread by the truck as it moves along. When not in use as a dump body, the steel sides and steel tail gate are instantly removable and side stake gates 36 inches high are substituted in their place, and a stake-body tail gate which hinges at bottom placed in position. A 10-inch and 14-inch wood reinforced tail gate, when lowered, extends platform length to a practical 10-, 12- and 13-foot stake body in the two-, three-and-one-half and four-tonners, respectively. The sub-frame is built of rolled steel channel and the floors are covered with 14-pound steel plates, fastened with bolts. The four-ton truck body for rock, sand and gravel has a length of 132 inches and a width of 80 inches, the height being 15 inches.



While one trailer (extreme left) is being loaded, the tractor is hauling a loaded trailer (left center) or returning with an empty trailer (right center), while all the time another trailer is being unloaded (extreme right) at the other end of the run

A graphic argument setting forth the manner in which the trailer saves time and money by keeping the truck in constant motion

The measure of a want is filled when prompt, willing and efficient Service is added to Inherent Values

Adjusting A. C. rotor starting resistance

Preparing to rewind A. C. stator

Dipping coils in insulating compound

Soldering connections of rewound stator

Repairing fractional horsepower armatures

Look for this mark of leadership in electrical development and manufacture

Inserting the first coil of stator under repair

From Coast to Coast G-E Motor Users are Triply Protected

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45-180

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of Interest to Farmers

GOPHER TRAP.—S. F. STANKIEWICZ, Randon, Ore. An object of the invention is to provide an animal trap more especially for catching gophers, moles and other burrowing rodents. Another object is to provide a light metal trap which is strong in construction and which may catch two animals simultaneously, and that may catch the animal going into or out of the burrow.

TRACTOR.—E. E. LARSON, 651 S. Park Ave., Mason City, Iowa. The invention relates to tractors characterized by propelling members of the walking type. The tractor compresses rolling means supporting one end of the frame, endless tracks associate with the other end of the frame, a carriage on each of the tracks, a shoe associated with each of the carriages, and means associated with the shoe for accelerating the movement of the carriage when the shoe is moved from inoperative to operative position.

Of General Interest

UMBRELLA AND PARASOL.—I. H. WEINBERG and C. F. BISBING, 23 E. 21st St., New York, N. Y. An object of the invention is to provide an attachment which operates to hold the ribs of the umbrella or parasol close to the handle and which also provides a convenient means for supporting the umbrella on the wrist or arm of the user. A further object is to provide an attachment which can be conveniently located on any ordinary umbrella or parasol and which will also be ornamental and attractive.

DATE STAMP LOCK.—A. MILLER, 70 Greenwood Ave., East Orange, N. J. Among the objects of the invention is to provide means for use in connection with conventional and standard type dating stamps for locking the type in alined printing position. It is also an object to provide a device which may be mounted upon the available space of the base plate of ordinary dating stamps, and which will compressibly engage the several type-carrying belts.

WEATHER STRIP.—C. J. JONES, 1319 Champa St., Denver, Colo. This invention has for its object to provide a weather strip for the meeting edges of window sash and frame, the meeting rails of the sash or the meeting faces of the door frame and door, which serve to keep out air and which form a snug juncture of the parts to prevent rattling. The device may be readily attached without skilled labor.

COLLAPSIBLE TUBE.—E. L. CLEVELAND, 941 Ainsworth Ave., Tacoma, Wash. The invention has reference more particularly to that class of tubes which are adapted to contain tooth paste and other plastic or semi-plastic materials and from which the contents are discharged by distorting the tube. The primary object is to provide means whereby a given quantity of the contents may be expelled without having the discharge continue after the pressure has been relieved.

COMPOUND CRAWLER.—E. RIMAILHO, 12 Rue de la Rochefoucauld, Paris, France. The object of this invention is to provide a compound crawler tractor with steerable propelling means which is particularly useful with gun carriages of heavy artillery, and for transporting and firing ordnance as well as for transporting loads of any kind, since it provides means for moving them on varying ground, while still allowing their travel on the road by their usual means.

BRUSH HANGER AND PAD REMOVER.—M. P. BENSON and M. M. WIENER, Monarch Brush Co., Troy, N. Y. Among the objects of the invention is to provide a hair brush comprising a rigid back with integral handle and a flexible removable pad carrying the bristles, the pad being removable for the purpose of cleansing, or other purposes, the specific object being to provide a means for ejecting the pad from the brush back.

CLAMP.—S. R. LIBBEY, Brady, Mont. The invention has for its object to provide a clamp especially adapted for use in connection with tubs to clamp a cover of flexible material over the tub without the use of nails, staples or the like. In practice a corrugated wire is used for providing resiliency in the event of expansion and contraction; the clamp is adapted to receive a seal.

DISPLAY STAND.—J. M. WALTERS, c/o J. W. Robinson Co., 7th and Grand Ave., Los Angeles, Cal. Among the objects of this invention is to provide a form of stand adapted for the display of evening gowns and lingerie, underwear and the like, wherein the fixture is so constructed that it will be hidden by the garment displayed. A series of attachments for each class of article to be displayed is provided for connection with the stand.

CAMERA.—C. G. JOHNSON, Eau Claire, Wis. The object of the invention is to provide mechanism in connection with folding cameras for permitting an exposure to be made on a lesser portion of the film than is usually exposed, provision being made for varying the size of the film desired for exposure, or permitting a picture to be taken the full size for which the camera was originally intended.

ALLOY.—V. P. TAYLOR, address 2.A. Dr. Bilisano, Dominguez, 42 Mexico D.4. Mexico. This invention relates to a metal compound, and aims to provide a product which will combine practically the lightness of aluminum with the strength of extremely hard metals. The alloy contains aluminum 80 to 100 parts, copper 8 to 17 parts. After the mixture has been melted small quantities of sodium tungstate, potassium, bichromate, and finely granulated cast iron are added.

DETACHABLE TOOTH.—C. A. CONOVER, Newburgh, N. Y. The invention relates particularly to a removable tooth, and has for an object to provide a construciton which will be mechanically effective for the purpose desired, and at the same time a construction which will present a pleasing appearance. The construction is capable of application to a bridge or crown, and may be applied at any time on the upper or lower jaw.

APPARATUS FOR EXTRACTING RESIN AND ALLIED PRODUCTS.—W. EDENBORN, c/o La. Railway & Navigation Co., 520 Hibernia Bank Bldg., New Orleans, La. Among the principal objects of the invention are to avoid retreatment of wood particles for the separation of resin previously extracted therefrom, to reduce the cost and simplify the method of extracting resin from wood particles, and to reduce the time factor for the extraction.

Hardware and Tools

TOOL FOR ALINING AND FITTING MACHINE PARTS.—J. PEYER, 634 2nd St., Brooklyn, N. Y. Among the principal objects of the invention is to remove the necessity for performing the work for which the tool is designed under cramped or inverted positions, to insure greater accuracy in the work performed, and to correlate the various operations incident to alining and fitting machine parts. A broad purpose is to provide a tool to be used for fitting and realining the wrist pin bearings and connecting rod bearings in automobile engines.

DOOR LOCK.—E. E. L. MONTELIUS, 113 E. 75th St., New York, N. Y. This invention pertains more particularly to a door lock used in connection with a dumb-waiter shaft, which will render such doors incapable of being opened unless operated by a person in charge who would be in the basement of the building. A further object of the invention is to provide means associated with the lock which will prevent the unlocking of any doors other than those to the rear of which the dumb-waiter is positioned.

BUTTING TOOL.—R. W. AYLING, 427 17th St., West New York, N. J. The invention relates to tools used in temporarily bolting sheet-plates together, and has for an object the provision of a construction wherein the tool will coact with a wedge for causing a temporary bolt to be properly positioned when acting as clamping means for holding two sheets of plate together. A further object is to provide a tool which may be held manually.

WINDOW SCREEN CATCH.—J. B. BRADLEY, Box 1230, Miami, Fla. The invention relates generally to window screens, and more particularly to window screens which are hingedly connected adjacent to their upper side portions to swing at their lower portions toward and away from the sub-sill of the window frame; the object is the provision of a simple inexpensive catch fastening capable of ready adjustment and ready installation as well as durability.

Heating and Lighting

OIL BURNER.—W. B. BOOKER, Freeport, Texas. This invention relates more particularly to a burner designed primarily for burning crude fuel oil, an object being to provide a construction which insures the centering of the oil discharge spray head within the burner head. A further object is to provide means for submitting the oil to the temperature of steam before reaching the burner so as to vaporize the oil and insure a perfect mixture with the steam for burning.

GUARD FOR GAS STOVE COCKS.—J. LAYDON, 268 19th St., Brooklyn, N. Y. The general object of the invention is to provide an attachment to be applied to a gas stove to prevent the accidental opening of the gas cocks by a person brushing past the same or the striking of the handle of the cock by another object. A further object is to provide a device which is simple and may be readily adjusted to close and guard those cocks not in use yet permitting any selected cock to be opened.

OVEN GRILL.—G. B. CASWELL, address Wm. Calhoun, Ast. E. & R. Officer, Fort Terry, N. Y. The object of this invention is to provide a grill fitting into the oven and adapted to support one or more food containers and arranged to permit the user to readily raise the containers from normal lowermost position to any desired height in the oven without danger of spilling the food, shaking it or otherwise handling it to detriment of the food.

Machines and Mechanical Devices

TEXTILE FABRIC TREATING MACHINE.—L. CLARENBACH, 159 Hamilton Ave., Passaic, N. J. The invention relates to machines for treating textile fabrics in the open width with liquid, and has for its principal object to provide a machine in which the liquid is caused to thoroughly penetrate the fabric as it passes there through in a minimum time and uniformly, the fabric being forced against the liquid.

OPTICAL PRINTER.—H. B. BYRON, 359 E. 155th St., New York, N. Y. This invention has particular reference to photographing machines having a fixed optical center. Among the objects is to provide a negative holder having a plurality of light apertures adapted to be brought in succession into the axis of the light with facility and optical precision, whereby a more rapid or more perfect adjustment may be effected than would ordinarily be possible.

OIL ABSORBING DEVICE.—A. E. ALLEN, 25 72nd St., Brooklyn, N. Y. The invention relates to an oil absorbing device adapted to engage the needle bar of sewing machines to absorb any excess of oil which may accumulate on the needle bar. The primary object is to provide a device which may be easily applied and manufactured at a modest cost.

COMPENSATING APPARATUS FOR WELL DIGGING OUTFITS.—O. E. OAKES, Baxter Springs, Kas. A specific object of the invention is to provide a frame with reciprocally mounted spring-held pulleys to which a wire line is applied and which is so employed in connection with the drilling outfit that the springs are made to take up shocks and unusual strains in the drill cable to prevent breakage thereof.

PUMP.—W. R. TWIFORD, Manville, Wyoming. Among the objects of the invention is to provide a pump that is easy to operate, the column of water in the delivery pipe being counterbalanced by the pump plunger in a different pipe, to provide a pump in which the working parts are subjected to the least amount of wear, and being so designed that sand or other solid particles that may pass upward from the well with the water will never come in contact with the working parts of the pump.

HANGER BLOCK.—P. A. FRIEL, 84 W. 6th St., Bayonne, N. J. This invention relates to mechanical connectors and has particular reference to means for attaching planks, beams, studding, or the like to concrete or composite girders, posts, walls, etc. Among the objects is to provide a connector or hanger block adapted to be secured or snubbed to the flange of an I-channel or T-beam during the construction of a composite building element such as a girder.

Prime Movers and Their Accessories

PRESSURE REGULATOR.—L. LEBRAS, 219 W. 66th St., New York, N. Y. The invention relates more particularly to an automaitc controlling device for the pressure of air utilized in liquid fuel feeding devices, such as commonly employed for internal combustion engines in connection with aviation motors or other forms of motor-propelled vehicles. An object being to provide an apparatus which will insure the maintenance of a uniform pressure in the liquid fuel tank for feeding fuel to the carburetors.

INTERNAL COMBUSTION ENGINE.—G. B. GERAU, 1393 E. 82nd St., Cleveland, Ohio. An object of the invention is to provide a shuttle valve piston for an internal combustion engine, the arrangement being such that the necessary valve mechanism is embodied in the piston and operated from the crosshead of the connecting rod, thereby eliminating a considerable portion of the weight of the engine ordinarily represented by the cam shafts, lift rods, etc.

BREATHER FOR GAS ENGINES. — A. PAJALIC, Dearborn, Mich. An important object of the invention is to provide a breather, which will serve to allow free escape of compression from the crank case, and will serve to separate and return to the crank case any entrained oil or the like. Another object is to provide for the exclusion of dust or other foreign substances from the crank case and for allowing for the admission of air.

Pertaining to Recreation

TOY AIRPLANE.—A. Z. BAKER, 301 Washington St., Newark, N. J. A general purpose of the invention is to provide a toy airplane of the knock-down or dismantled type in order that it may be packed for the market in comparatively small cartons to facilitate transportation and distribution. A further purpose is to provide a toy airplane assembling the wings, to eliminate the use of permanent structural means such as screws, nails or tacks.

Pertaining to Vehicles

AUTOMOBILE BODY CONSTRUCTION.—J. J. JONES, 145 S. Hillside, Wichita, Kan. The invention relates more particularly to small light vehicles including four-wheeled frames, but which are known as cycle cars. This type of vehicle is distinguished for its minimum air resistance, its light weight, its low center of gravity increasing its tractive qualities, but is ordinarily limited to two passengers. The object of the invention is to provide a body construction which will permit of the seating of four passengers comfortably without great increase of weight.

LUBRICATING MEANS FOR LEAF SPRINGS.—H. RIGBY, 899 E. 19th St., Paterson, N. J. The object of the invention is to provide means for lubricating leaf springs of automobiles and other vehicles and devices arranged to permit the use of standard parts thereby reducing the cost of manufacture to a minimum and to permit convenient replacement of the parts, if necessary.

AUTOMOBILE LOCK.—J. W. HUNTER and E. WILLIAMSON, Mobile, Ala. An object of the invention is to provide a lock or holding device for automobiles, which will prevent turning movement of the steering wheel and which can be readily moved out of the way when not in locking position, and securely locked when in position to hold the wheel, and prevent steering by any one except the rightful owner.

TRANSMISSION CASE.—G. H. PADGETT, Pinecastle, Orange County, Fla. The aim of this invention is to provide a case construction in such manner that it will be possible for access to be had to the transmission without the destruction of the oil-proof gaskets and with which the entire operation may be completed by one man in a fraction of the time usually required by two; furthermore it is not necessary with this device for the operator to be under the car.

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Something Different in Salvaging Operations

(*Continued from page 518*)

lower end, designed to engage the bottom edge of the trunks and to discharge into the water surrounding these structures. In fact, the ease with which the crook-like pipes could be got into place from the surface and the certainty with which the air could then be controlled from the salvage craft made them the principal aid by which the buoyant medium was manipulated during the refloating of the "Canadian Recruit." It should be understood that the under-water plating of the hull abaft the engineroom was intact and necessitated no repairs in the region where compressed air was applied. Forward of the after bulkhead in the engineroom, however, divers had to patch the injured shell. With that done, the unwatering of that section of the steamer resolved itself into a simple job of pumping, for the deck and hatches throughout that stretch to the bow were above the surface of the river.

By reference to Fig. 3 it will be seen that the stern of the steamer rose to the surface when sufficient air had been forced into the cargo space; and it will be observed that the level of the water in the trunk coincided with that of the surface of the river. In Fig. 4, however, the moment before the vessel righted herself and ceased to rise higher, it will be noticed that the level of the water in the trunk was below that of the river and yet higher than the surface of the water generally in the hold. This plainly indicates the thrust of the confined air and the manner in which the movement of the column of water in the trunk served to relieve the bursting pressure of the compressed air. A few moments later the air was free to escape upward into the trunk, and the superposed water was blown into bubbles and spray like a sizzling bottle of soda.

This new salvage device, so simple in its get-up and comparatively easy to instal, furnishes at once a ready solution of many of the vexing questions involved in raising a deeply sunken ship by recourse to compressed air applied internally. Where the circumstances permit its employment it does away with the need of ordinary compensating apparatus, because each trunk becomes in effect a great automatic relief valve that can be depended upon to function correctly as the enveloping hydrostatic conditions alter. It was just the absence of any prompt and ample means for taking care of the expanding air, as the ship rose, which frustrated one of the initial stages of the refloating of the U. S. S. "Yankee."

Active work on the "Canadian Recruit" was started on the 16th of May of the present year, and she was floated clear of the shoals fifty days later, forty days of that interval having been taken up in removing cargo. Ten minutes after air was turned into the after hold her stern rose clear above the tide.

A New Magnesium Alloy for Motor Pistons

(*Continued from page 519*)

Where this metal is re-worked or rolled, drawn, drop forged or heat treated, the tensile strength is increased at each operation. In heat treating, sand castings are increased from 22,000 up to 30,000 pounds, without causing any appreciable change in the yield point, while the elongation and reduction in area are increased 6 per cent. In drop forging, the tensile strength is increased to 50,000 pounds and the Brinell hardness rises to 70 or better.

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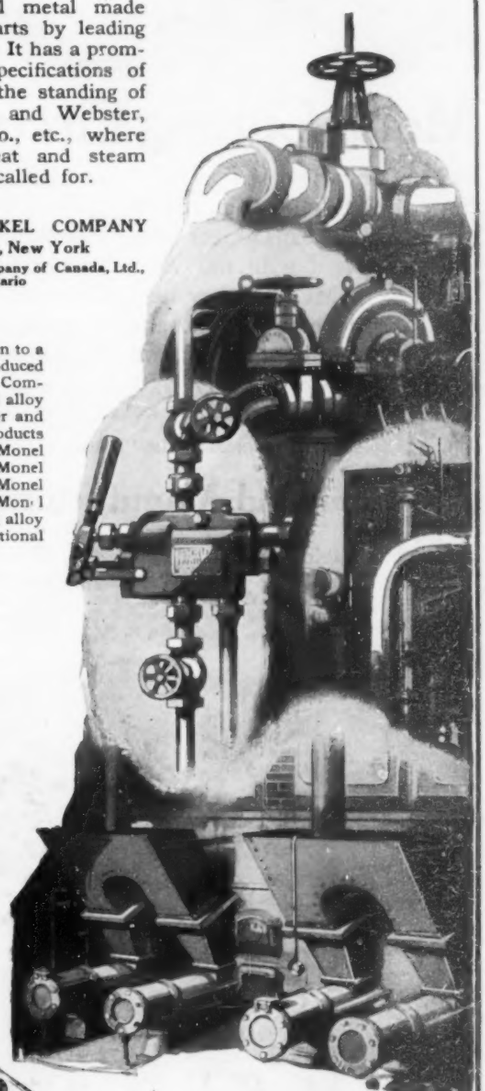

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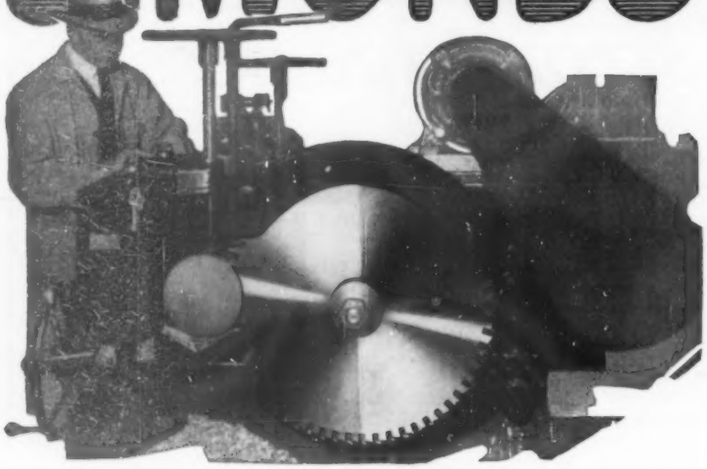

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sion of the test, the piston showed very little wear and the cylinder none.

A recent test in a plant of a well-known manufacturer of motors showed that these motors developed six horse-power more with the new metal pistons than they had ever developed before with any other material. In spite of the rather ample clearances with which these pistons are installed in the cylinder, no case of oil pumping has yet been recorded and the objectionable piston slap is absent. The possible applications in the automobile and in airplanes are apparent to the automotive engineer.

A Giant Ingot Mold Casting in the Making

(*Continued from page 519*)

Owing to the height of the casting, and the consequent high head of liquid metal, it can readily be seen that the pressure at the bottom of the mold would be a serious factor in pouring this casting; in fact, the pressure at the bottom would be so great that there would be a tendency to crush the core and force the walls of the mold inward, thereby reducing the diameter of the casting at this point. One of the problems, therefore, was to construct the core so that it would be sufficiently strong to withstand this crushing tendency and at the same time be sufficiently pliant so that it would yield to the shrinking process which takes place as the casting cools. It should be sufficiently porous to allow the escape of the gases that are generated in the core through contact with the heat of the molten metal. As the rate of shrinkage in the diameters at the bottom of the mold would be different from that at the top, it was, of course, necessary to regulate the diameters of the core and mold at the top and bottom to such a degree of nicety that when completely cooled and all shrinkage had ceased, the resultant diameters would be alike at both ends of the casting. One of the illustrations shows the special core being lowered into the mold in the ground. The weight of the finished casting was approximately 114 tons, but to pour it there was provided a total quantity of 135 tons, the excess representing gates, runners and the riser which was cast on the mold as mentioned. In order to have this large quantity of metal ready for pouring at one time, it was necessary to make special provision for storing a large portion of it. This was done by building adjacent to the mold a large reservoir with a capacity of 70 tons. This reservoir was made up of cast iron pigs and properly lined with fire brick and clay to hold the molten metal. In addition there were three ladles of molten metal holding respectively 25, 30 and 10 tons. The 70-ton reservoir was connected to the mold by means of a trough, and at the proper moment the plug at the bottom of the reservoir was withdrawn and the molten metal released and conveyed to the mold through the trough. At the same time the ladles were poured into the mold through other similar runners.

Aircraft of the Future

(*Continued from page 520*)

small variations in altitude as are the planes of today, for the whole use of the air as a means of transportation means the use of all levels where life can be sustained, and the running of passenger and freight planes where they will meet the least resistance and consequently operate with the greatest economy.

The problem of the air-screw (propeller) receives a great deal of attention at the hands of the committee. They summarize the outstanding problem as one involving the construction of a screw with blades adjustable in pitch. The problem is twofold, involving (1) determination of its aerodynamic proportions and pitch so that under widely varying conditions of flight at varying altitudes, varying speeds and varying degrees of climbing, the screw may present always the most satisfactory curvatures to accomplish the desired end with the available power; and (2) the construction of such a screw.

The determination of the theoretical proportions is a problem well in hand. The making of such a propeller which shall properly function has not yet been achieved. So it is proper material for a prophecy to the effect that the airplane of the future will have adjustable propellers capable of combining with its variable wing-surface and camber to produce variations of speed, lift and revolution-per-minute, to the end that a plane be able to function most effectively at many speeds and altitudes with the minimum of power and weight.

The committee finds that the greatest problem of all is the "best economic utilization of the enormous investment which has been made in aeronautical production, expressed in terms of money and human time and energy."

Basing, then, the final prophecy upon the final problem, it seems inevitable to state that the plane of the future will have at least as great a part to play as steam transportation has had in the development of civilization. That the airplane will eventually make war impossible because too destructive of civilian life is the hope of those who see universal peace not as a vision but as a practical possibility. That the airplane will eliminate time and distance in a wholly new sense is already assured. That it can only do so commercially by being made entirely safe and wholly economic is obvious. That the path to these desired fields lie through the speedy solution of mechanical problems here outlined hardly needs demonstration—that this "prophecy" of what the plane of the future must be is based upon concrete facts and not at all upon fancy is its only excuse for being.

Our Coal in the Making

(*Continued from page 522*)

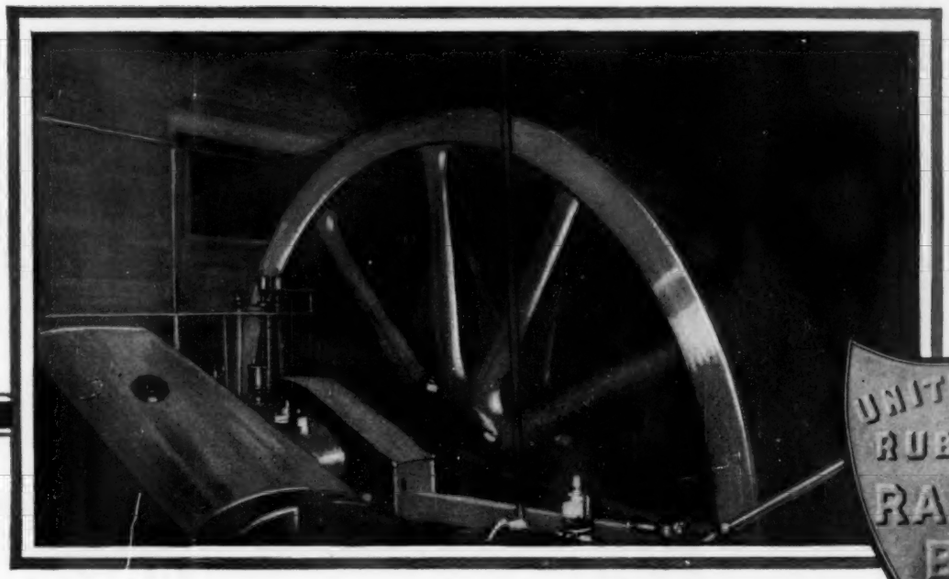
ward speed of the tractor-like machine is such that enough raw material is excavated, macerated and dried to prepare from 5 to 10 tons of dry fuel for each working hour. The machine may be operated by gas or electric motor, but about 50 horse-power is required. One man operates the machine. The cost of peat fuel, so prepared, Mr. Garnett estimates at about $2.25 per ton at the swamp.

During the process of maceration a glue-like substance held in the plant cells is liberated and this acts as a cement for holding the briquets together and as a waterproofing agent. It will be noted that the raw peat is placed on the ground, which is, first, the easiest place to put it; and, second, has the advantage of keeping the under side of the bricks moist, permitting the moisture to be driven upward by contraction of the bricks. Bricks dried in racks often crack to pieces due to rapid surface drying. After the bricks are dried they are taken up by hand and then are run through a crusher and delivered to the consumer for hand firing, the same as crushed coke, the size being determined by local requirements.

A Minneapolis company has made extensive experiments in the preparation of a pulverized fuel from this peat and they have obtained surprising results in firing pulverized peat in competition with pulverized coal.

Tests recently run in a big office building in Minneapolis showed that the evaporation per pound of coal was only ten per cent higher than per pound of peat. This appears to contradict the fact that the B.t.u. value of the peat was only about two-thirds that of the coal. But credit is not given in the B.t.u. test for the fact that the peat contains very little carbon and burns with almost no ash, and in addition contains oxygen of its own, which the coal must obtain from the air. This latter is a very important consideration,

(*Continued on page 534*)



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The strength of the *Marine Corps*, including September figures: Officers, 1,065; enlisted men, 17,350; total, 18,415.

The *National Guard*, which is rapidly increasing in strength was to September 30, 1920: Officers, 2,642: men, 62,903; total, 65,545.

The Army and Navy Journal
W. C. & F. P. Church, *Publishers*
20 VESEY STREET NEW YORK CITY

Our Coal in the Making

(*Continued from page 532*)

for in obtaining oxygen from the air a very large amount of inert gases must be heated to combustion heat and these do no work. The peat is burned with the dampers almost closed, using only about one-half the air required to sustain combustion in the coal.

Burner equipment, it is claimed, for pulverized peat costs only about 80 per cent of the value of automatic stoker equipment, maintenance costs are about 60 per cent less, and the fuel delivered under the boiler costs less than $5 a ton. If these facts are borne out in practice, it is clear that there is a large and immediate field for such fuel.

About one-seventh of the total peat lands in the United States are located in Michigan and experiments being conducted at Chelsea, Mich., by G. A. Willmarth, a peat engineer, are scarcely less interesting than those going on at Minneapolis. Mr. Willmarth has turned his attention to the production of coke from peat and has succeeded in making a product of commercial value, which can be used to replace the expensive charcoal made from hardwood, and in making a peat fuel with a heat value claimed to be over 13,000 B.t.u., surpassing bituminous coal and equaling anthracite in heat value.

In this process only a part of the peat is artificially dried and this is turned into coke and ground with the raw peat. This serves to break up the water cells. The mixture is molded into briquets by a special machine and these are air-dried in sheds. The process, briefly, is as follows:

A coking retort is filled with air-dried peat and fire started in the usual way. Then, as raw peat is taken from the bog, it is first run through a disintegrator, a heavy machine that has two rolls, 12 by 22 inches, with tool-steel cutting bars extending from the rolls and running at speeds of 100 and 900 revolutions, respectively. As the peat passes between these rolls it is at once crushed and cut up, together with all foreign substances.

Then it is elevated to a hopper over the "pug mill," which cuts and grinds the peat to a loose granular form. Thence it is sent to a dryer, specially designed for the purpose. It is a drum 3 feet in diameter and 12 feet long, having parallel strips on the inside for lifting the peat as the drum revolves and dropping it upon adjustable slotted disks. Waste heat is drawn from the retort, together with the hot gases from the gas engine and these are forced through the drum by a fan and pass off out the smokestack. The peat, when it reaches an air-dried condition is discharged to the hopper above the retort.

After the retort is filled and the fire started, the gas and tar rapidly pass off to a purifier and scrubber. The scrubber is an upright tank, partly filled with coke, which is sprayed continuously with water. The gases are drawn upward through the coke and the tar is removed by the spray, the gases being forced into a gas holder by a centrifugal pump.

The retort holds 72 cubic feet or 1,440 pounds of air-dried peat, and this will make 8,500 cubic feet of gas, 10½ gallons of tar, and 650 pounds of coke, or 800 pounds of half-coke. The gas is used for power purposes, heating, etc.

The coke, which is then about one-half the weight of the peat used, is elevated to a hopper in which raw peat, which has been disintegrated, is also placed. After being thoroughly mixed and ground in the pug mill, it is sent to the smooth roll grinder, which is a heavy machine having two adjustable steel rollers, 12 by 22 inches, running at different speeds, so that the coke is crushed with the peat.

Here is really the secret of the whole process. When the granules of the coke are crushed with the raw peat, the minute water cells are broken. The plas-

Little Accidents

often produce painful if not serious results. Whether it is a pounded thumb, a bruise or a cut, for safety's sake treat it immediately with Absorbine, Jr., the handy and dependable home doctor that always brings relief.

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tic mass is then pressed into bricks on a special machine and these are conveyed to sheds, where they dry very quickly. Used for heating purposes exactly as coal would be used this fuel is said by persons who have used it to be a superior product. It is easily kindled, burns freely and gives an intense heat. If the drafts are closed it will keep fire for a long time and when the drafts are opened a good fire will be had almost immediately. It is cleaner than coal and more easily managed. There is very little smoke and no soot and it leaves no clinkers, only a soft light ash.

Some fifteen years ago a number of highly ingenious but useless machines were designed and built in this country for the manufacture of peat briquets. The inventors failed, however, to take into consideration the nature of the raw peat and without exception their product was a commercial failure. The public was induced to invest thousands of dollars in these enterprises and undoubtedly this experience has had a great deal to do with the lack of progress here in recent years.

Taming the River Nile

(*Continued from page 524*)

storage, the Blue Nile to irrigate Soudan, sounds easy enough, but political considerations immediately came into the picture. The government of the Soudan is double-headed. The country is called a condominion because it is part Egyptian, part English. It flies both flags. England had to have a hand in it after the affair which culminated with the loss of Gordon at Khartoum, and she made the country partly English by force of arms. All its officials are English. But the Soudan is not Egypt and Egyptians stood aghast at the proposition to dam the sources of the Egyptian Nile proper. The Blue and White Nile dams were threats to throttle the very life of Egypt before ever it got to Egypt. Moreover, Col. M. R. Kennedy, Chief of Public Works of the Soudan, expressed a belief there was not enough water for all the proposed dams and irrigation, and that the end would be a robbery of Egypt.

Nevertheless, war knows no pity and little equity. England could not wait and passed a bill, gave Soudan the money and the Blue Nile dam was begun to supply water for cotton to be farmed by an English syndicate.

There was a politico-irrigation cyclone immediately. Willcocks and Kennedy made charges, even criminal charges, against MacDonald, saying among other things that he had falsified water records to get the bill through, and the Fellaheen of Egypt, who knew little of politics but much of water and dams and irrigation, stirred up such a row that to settle matters, commissions were appointed to investigate, three of them in succession. The first two were neither listened to nor honored—the first because only bureaucrats were members, the second because the decision was against Egypt. To still the noise, England appointed a third commission.

Egypt and her Fellaheen had protested so loudly against unfair commissions that this commission was to be unprotestable. And Egypt and the Fellaheen had heard both of American irrigation, of American engineers and their startling ingenuity, and Egypt and the Fellaheen believed in the land of the square deal and fair play. So England invited America's leading irrigation expert to form the third member of the Nile Commission, and Mr. H. T. Cory, the "boss of the Colorado River," who made the Imperial Valley the "Egypt of America," became the third member.

The Nile Commission met in Cairo in February of this year and under Judge Booth in a mixed court in Cairo took sworn testimony for four weeks as to the charges against Sir Murdoch MacDonald and finished with going over the project physically as well as by plans and testi-

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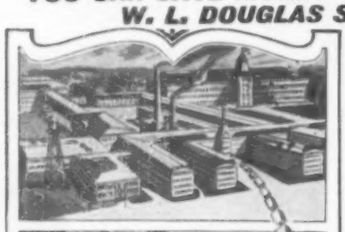

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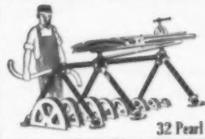

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mony. The charges against MacDonald were found to be without basis; it was ascertained there was water enough for all, and, on a strictly engineering basis, the projects were recommended to go forward to completion.

Briefly, these huge engineering works include two dams (now under construction) a storage on the Blue Nile of nine million acre-feet of water, and a canal, to abort the swamp in the Sudd region which now absorbs the greater part of the White Nile flow. The White Nile has its rise in Lakes Albert and Victoria, and if the swamp loss is cut off the storage in these lakes will be vastly increased. But the canal will be 225 miles long and twice the excavation yardage of the Panama Canal. When finished the whole project will conserve eighty per cent of the mean annual flow of the Nile, will cost fifty million Egyptian pounds ($250,000,000), will irrigate 10,000,000 acres (double the present acreage), and put five million acres in cotton. As a measure of comparison let it be said that in the United States we irrigate 32,500,000 acres.

Keeping Tabs on Bird Peculiarities

(*Continued from page 525*)

only when a bad storm indicates the permanent approach of colder weather. Bird banding work has been under headway for some time in England, Germany and Denmark so that the data from abroad, in many instances, will be available to check the findings ascertained in this country.

By the location of feeding and registering stations along the migratory routes, the government authorities hope to obtain interesting data concerning the speed of migration as well as the affinity of birds for certain nest sites. For many years people interested in bird life have contended that the same birds returned to the same nest each year. If this is true it indicates that a pair of birds will mate for life. Uncle Sam is anxious to ascertain definite facts in this regard. Considerable is known about the habits of the different species of land birds but little is on official record relative to the characteristics of the individual birds of the different families. For example, the class characteristic of the cardinal is to fight and squeal when first captured. However, several cardinals have been snared by representatives of the Biological Survey which displayed neither of these qualities but which were extremely docile and tractable as soon as they were captured.

Some birds acquire full plumage in a single year. Others, like the oriole, take several years to develop their permanent overcoats of feathers. A certain variety of the heron family which breeds commonly in the southern swamps in juvenile plumage is always white, while in adult garb its dress changes to blue. Peculiarly enough, some of the birds of this species at the age of about one year display what is known as calico plumage—a mottled kind of white dress. It is only through a comprehensive and continuous campaign of banding and registering the birds in all sections of the country, such as that to be inaugurated by the Federal Government, that complete and definite data concerning the why, when, where and how of bird doings will be collected and correctly interpreted.

Mr. S. Prentiss Baldwin of Cleveland, Ohio, and Thomasville, Georgia, has conducted some of the most important bird-banding and systematic trapping investigations attempted in the United States. He reports that of over 5,000 or more birds which he has handled during the last five years not more than five have been seriously injured in the traps. His experiences indicate conclusively that the birds are, in no respect, harmed by the trapping and banding and that really the handling helps to tame the birds. The greatest source of damage to the captive birds are cats and that is why it is necessary to surround each trap with a guard fence which will prohibit these felines reaching the cages and worrying the birds.

The bird student who desires to essay bird feeding, banding and registering should first of all carefully scrutinize the game and bird laws of his State and ascertain positively from the local authorities whether the temporary catching of the birds for banding and registering constitutes a technical violation of the State laws. If necessary, it may be advisable for the enthusiast to secure a collector's permit in States where the local legislation is opposed to bird trapping. In the main, the feeding and protection accorded the birds by the people interested in studying their intimate habits and peculiarities completely overbalance any of the very rare injuries which result as a consequence of the fliers being held for short periods in captivity.

How Meadow Mice Destroy Trees

(*Continued from page 525*)

In the maple collection nearby at least two trees have been destroyed, and four Japanese maples in the Fruticetum have been girdled. In the case of one of the latter many of the lower limbs were covered with snow and these were entirely stripped of their bark. In the hawthorn collection, also, several trees have suffered in this way, but none appear to have been girdled.

Two lindens, one poplar, several wild cherries, and other trees scattered about the grounds have likewise suffered, but not to the same extent as the shrubs.

In the lilac collection recently installed on Pelham Parkway, containing many fine French varieties, between thirty and forty plants have been destroyed. In the weigela group north of the lake near the museum building twelve of the large clusters have been completely girdled; while at the Mosholu Approach and elsewhere, the weigelas have suffered severely.

The Georgia syringa collection is planted in a low spot in the Fruticetum, where there is much grass and the snow lingered long. Here the mice camped among the stems a foot or more above the ground and played havoc with nearly every one of them, eight large clumps being destroyed. The oriental sweet shrub on the bank above seemed to be especially attractive to the mice, eight of these clusters having been destroyed.

A group of deciduous holly was wiped out, shrubs of the pea family, privets, willows—almost anything within reach seemed acceptable to this small, lurking enemy, which is so difficult to combat. Nor was the loss confined to one locality. Reports from other sections indicate that the destruction by meadow mice last winter was much worse than ever before recorded. Toward the end of April I had an opportunity to see some of this destruction in the orchards about Yama Farms in Ulster County, New York. In one orchard visited, containing several hundred apple trees just coming into good bearing, not a single tree was spared. All of them were girdled clean for a space of from one to two feet above the ground.

Bridge grafting is often recommended to save trees not entirely girdled. Strips of fresh tissue are inserted during April, when growth is actively beginning and before the wounds have dried out, and the descent of food to the roots is thus insured. A tree wounded near the base, however, is always liable to attack by fungi, this being a very vulnerable point.

On May 6 I visited the grounds of the International Garden Club in Pelham Bay Park and saw beautiful climbing rose-bushes trained against a wall, gnawed clean by mice for a distance of three feet above the ground; and in a group of about thirty Japanese maples, twenty-one were girdled beyond hope of recovery. In a field near by, black locust trees over a foot in diameter were completely girdled, although the inner bark of this tree is considered poisonous to horses.

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